Electrical Construction and Maintenance

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JULY · 1947

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In This Issue

A McGRAW-HILL PUBLICATION

What other fluorescent ballasts meet these tests? Typical of the care that goes into the making of General Electric fluorescent lamp ballasts is the testing program which all materials—every part, must pass.

G-E Pyranol capacitors, which provide power-factor correction for the ballast, are a good example. Every material used in these capacitors—from the kraft paper to the non-flammable Pyranol liquid dielectric—is carefully tested. Winding is performed in an air conditioned room, under controlled humidity. Evacuation is precision controlled. Then, *every single capacitor* is subjected to tests for electrical characteristics, electrical faults, and possible leaks.

The care taken in selecting fine components for every G-E ballast is supplemented by six different checks for correct operating characteristics, in addition to continual quality tests on complete ballasts. Finally, each ballast is subject to selection for independent testing by Electrical Testing Laboratories, Inc.

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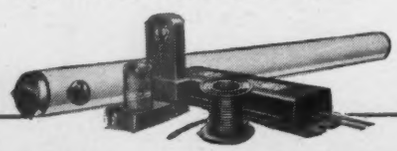

General Electric makes ballasts so you can install them and forget them. Their quietness, their ability to assure rated lamp life and light output, and their recognized reliability become your silent salesmen—to help keep your fixtures sold. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

413-8

Electrical Construction and Maintenance

With which is consolidated Electrical Contracting, The Electragist and Electrical Record...Established 1901

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering installations, repairing, maintenance and management, in the field of electrical construction and maintenance.

July • 1947

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JULY. . . . at a Glance

Labor Act

The new labor law becomes effective in periodic stages. It will be several months before the electrical construction industry can fully appraise its effects and the problems it may create. In the contracting industry, traditionally closed shop, the anti-discrimination clause with respect to union membership may be difficult, even costly, if the long established custom in hiring men from the local union continues. The ban on jurisdiction strikes and secondary boycotts is long overdue. By exposing such activities to damage suits they are made extremely expensive. Few but the most anti-social unions will be bothered much by the provisions which make unions legally liable for their conduct. We are preparing a comprehensive analysis of the new law and its probable effects on the electrical construction industry. Watch for it in next month's issue.

Church Lighting

There are more than 253,000 churches in the United States today. A high percentage of these are poorly lighted. Several thousand more churches have been and are being planned. Lighting and wiring for these new churches should account for from three to five percent of the total building cost. Thus a sizable market exists for lighting equipment and wiring in the relighting of old, and in the lighting of new churches. It is also one of the most exacting projects in lighting application. Lighting effects must be produced with the utmost consideration for the dignity and quiet of a place of worship. B. C. Cooper has prepared a well illustrated discussion of the fundamental factors and principles involved in successful church lighting in his article, "Church Lighting Techniques" on page 70 in this issue.

Volume-Duration

Effective job handling requires careful advance scheduling of the labor force that will be required and a clear understanding of optimum job duration. Manpower is necessarily a function of the volume of work. Optimum job duration can also be related to volume. Ray Ashley brings us an analysis of these important factors in estimating and job planning in a series of articles entitled, "Volume-Duration Studies" to begin in the September issue. Mr. Ashley's concluding article on "Labor Cost Variables" will be found on page 69 of this issue.

Win Recognition

One division of the Merit Award Competition for lighting plans to be held in connection with the 2nd International Lighting Show is devoted to plans submitted by electrical contractors. Contractors are invited to send in their proudest lighting achievements. They will earn national recognition and the best jobs will win $100 prizes. For the rules and information on how to enter your work, see "Awards for Lighting", page 73. Be sure to get your entries in before August 31.

Magnetics

Electric current flow always produces a magnetic field. In electrical construction and maintenance work we are usually concerned more with the current flow than with its magnetic effects, leaving that pretty much to the equipment designer. But the megnetic aspects of electricity are still an essential part of our understanding of power, light and wiring. You will find R. N. Eck's article, "Understanding Magnetics", beginning on page 97, an unusually clear and readable review of an often difficult subject.

Masonry Drilling

The carbide tipped steel bit which cuts into masonry, driven by an ordinary rotary drill, has had an almost revoluntionary effect on fastening costs, particularly on rewiring and renovation work in fireproof buildings. The cemented carbide tip which approaches the diamond in hardness cuts fast, smooth and accurate holes on jobs once considered tough and time consuming. This versatile and useful tool will give the best results if a few simple precautions are observed in its use and it is sharpened properly. In his article, "How to Use Carbide Drills", see page 78 of this issue, Harold York, Development Engineer with the Carboloy Company, gives some important hints on their use, care and maintenance.

Small Pipe Tool Needed

A new portable electrical tool employs an impact mechanism in the drive that gives it extraordinary versatility. When held against a heavy load, the tool is driven by sharp radial impacts — like tapping a wrench with a hammer. Thus, it can be used for drilling, tapping, reaming, nut running or screw driving and other chores that would normally require a variety of tools. Any electrical man who has seen this small six pound tool ream and tap a ½ inch hole would see in it, as we did, the possibility of a similar lightweight, hand held, power tool for threading ½ to 1 inch conduit. While conventional pipe machines are effective enough on the larger conduit sizes, they are rarely used on the job for anything under 1¼ inch. The branch circuit sizes, however, still constitute the great bulk of conduit work. It's high time the power tool manufacturers brought out a lightweight power pipe tool to fill the gap.

He writes only in RED INK!

INADEQUATE WIRING, the industrial jinx, embezzles millions every year. It would take quarts of red ink to record the toll he takes in unproductive wages, lost production and spoilage.

For, when he attacks, through overloaded, over-extended, obsolete wiring, efficiency can drop from 25 to 50 percent.

To shut out this costly scribe, talk to your plant power engineer, consulting engineer, electrical contractor or power salesman.* They can write him off... before he gets into your books.

47434

Because adequate wiring is basic ... and affects everyone in our industry ... Anaconda continues to promote this idea in a wide list of national magazines.

*WIRE AHEAD, a new booklet discussing preventive maintenance...the symptoms of inadequate wiring... and presenting plans for anticipating electrical demand, is now in preparation. We shall be glad to send it on request assoon as it is available.

ANACONDA from mine to consumer

ANACONDA WIRE & CABLE COMPANY

YOU ARE THE SALESMAN

LISTING THE LOCAL, regional and national activities current in the industry aimed at stimulating sales of electricity or electrical products and services would occupy several of these pages. Practically every facet of our industrial, commercial or home life where electricity plays a part is the target of a well conceived and competently planned program. As an industry we are wealthy indeed in progressive market development materials.

IN ACHIEVEMENT of industry objectives, however, there is little to cheer about. Two years after the war there is still an evident reluctance to put our full energies into market development even when the opportunities are obvious and the benefits clear. There is probably good reason in this attitude. The industry is busy. The individual's daily chores are burdensome and exacting.

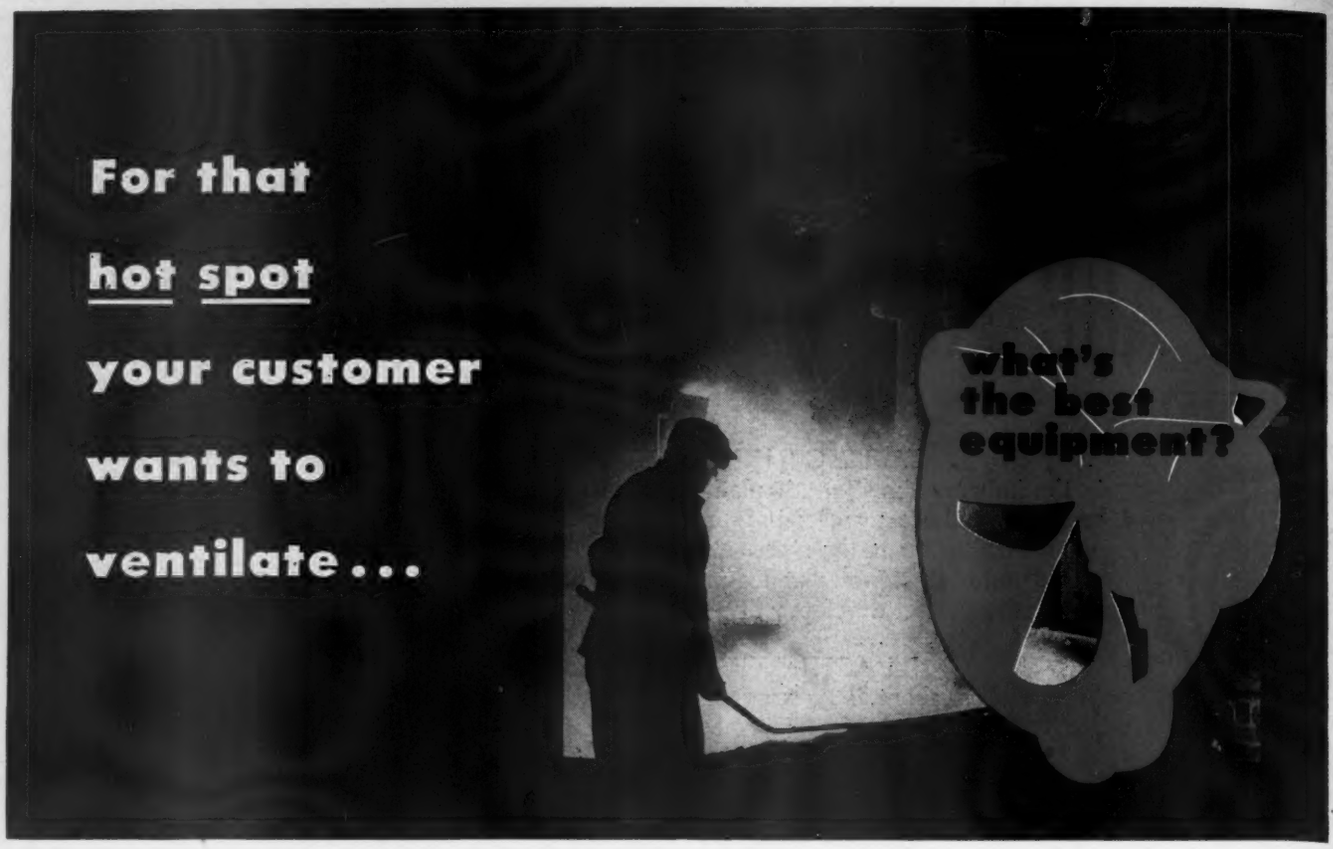
MARKET DEVELOPMENT is looked upon too often as a sort of intangible good, not too imperative, that will go on somehow even though we don't get around to it ourselves. How often in casual conversation we hear the uncritical abstraction "They ought to do something" or "There ought to be a campaign—" as though some external group existed which could do selling jobs that are clearly our own responsibility.

THERE ARE comparatively few men in the electrical construction industry or in electrical maintenance who carry the title "Salesman" on their business cards. But every one of us in his own circle of friends and acquaintances is a representative of the electrical industry. Our counsel is sought and respected on everything from utility rates to television. We are salesmen for our industry whether we want to be or not. And we carry the responsibility that goes with salesmanship to be well informed, reliable, and confident of our product.

WHAT WOULD HAPPEN if, by some persuasive catalyst this great body of sales personnel could consciously work on even a small part of our national market development opportunities? Our factories and shops would be swamped if a few hundred thousand persuasive electrical men suddenly recognized our complex, industry interdependence. How many adequate wiring jobs could such a sales force promote? How many planned lighting jobs, electric ranges or water heaters would be sold? How many labor hours of job security in profitable firms could such a force create?

YOU CAN WRITE THE ANSWERS. You are the salesman. The market development, the volume of business and the labor hours of secure employment in the electrical industry can be no more than it creates by the sales efforts of its own people.

Wm. F. Stuart



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Our national warehousing system can simplify your job of getting "everything electrical." Although it's still impossible for us to maintain complete stocks today, many items are available for immediate delivery. Call our nearest office. *Graybar Electric Company. Executive offices: Graybar Building, New York 17, N. Y.* 4744

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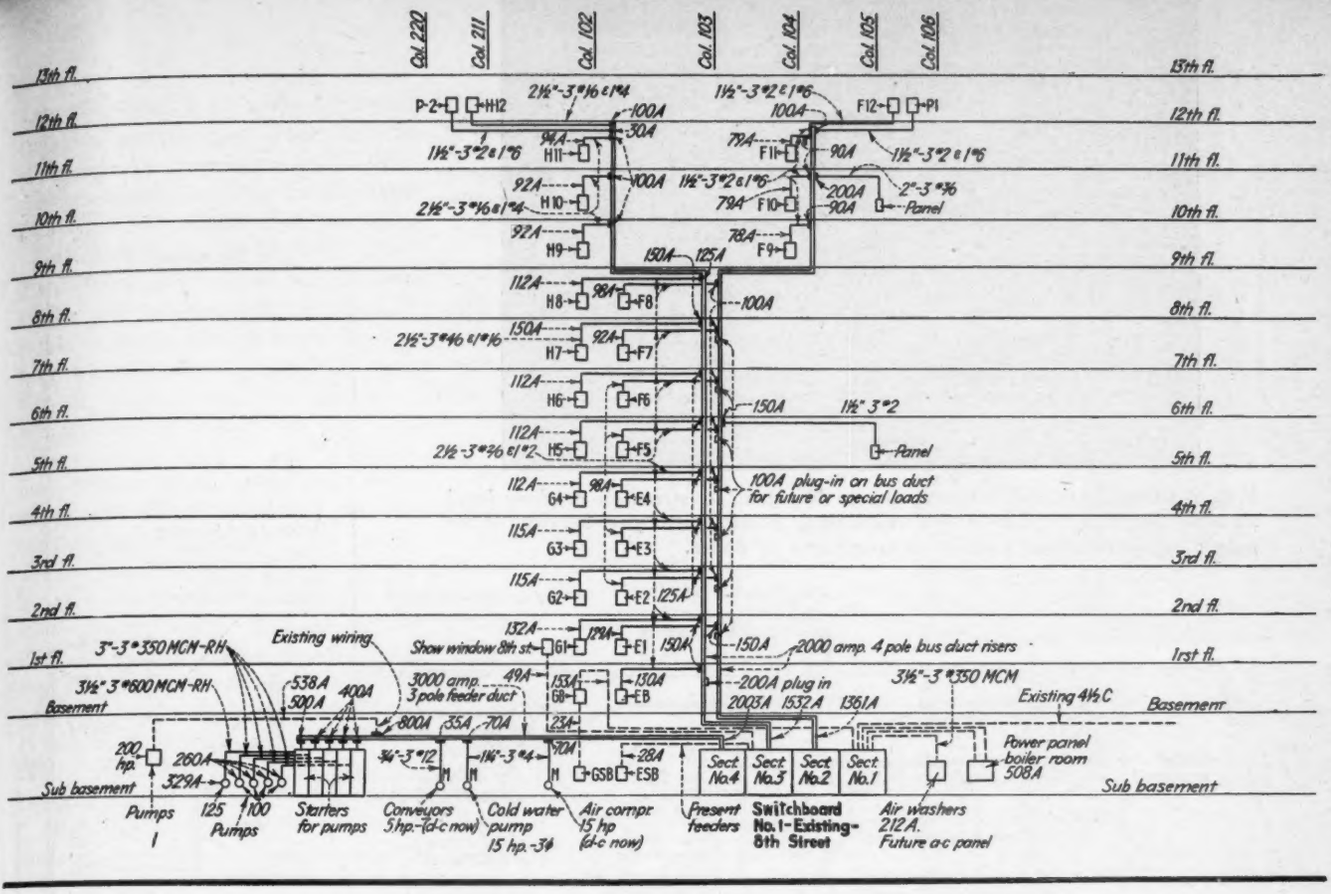


FIG. 1—Typical riser diagram illustrating vertical distribution with heavy-duty busduct. Note load balance and flexibility feature of spare plug-in facilities.

Bus Risers Serve Modern Store

Special busduct riser system provides unusual distribution flexibility at the 12-story Dayton Company Store in Minneapolis; may set pattern of future designs.

By August Eckel

PLUG a circuit breaker in a vertical feeder and additional power is available for special merchandise displays, style shows, or other special activities on any floor of The Dayton Company in Minneapolis, one of the midwest's leading department stores.

Such flexibility and capacity features characterize the design of a revamped and expanded electrical distribution system recently installed by the Kvalsten Electric Co., Inc., Minneapolis electrical contractors. Additional refinements simplify maintenance and load checking chores.

Studying details of the new bus riser system are building superintendent A. C. Renne (left) and G. L. Gustafson, construction engineer for Kvalsten Electric Co. Inc.

As building expansion continued to the present 12-story level, power and lighting requirements pyramided to an estimated 8,000 kw. connected load with a 4,500 kw. demand. Management's desire for a flexible, low-maintenance distribution focused attention on busduct as the logical means of handling the heavy present and anticipated electrical loads. Careful study of the problem by representatives of the Dayton Company, Kvalsten Electric Co., Inc., Frank Adam Electric Company and G. M. Orr Engineering

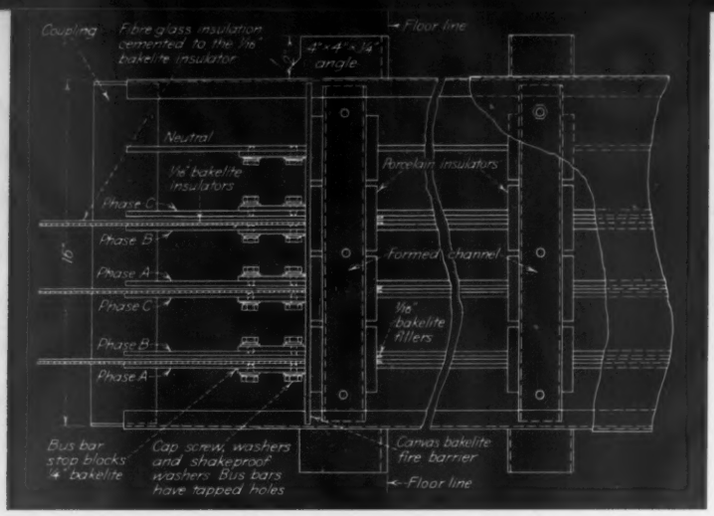


FIG. 2—Detail of 2,000-ampere, 4-pole bus duct construction at floor level showing bus bar insulators and supporting blocks; also fire barrier. Note paired, opposite-phase polarity arrangement of buses.

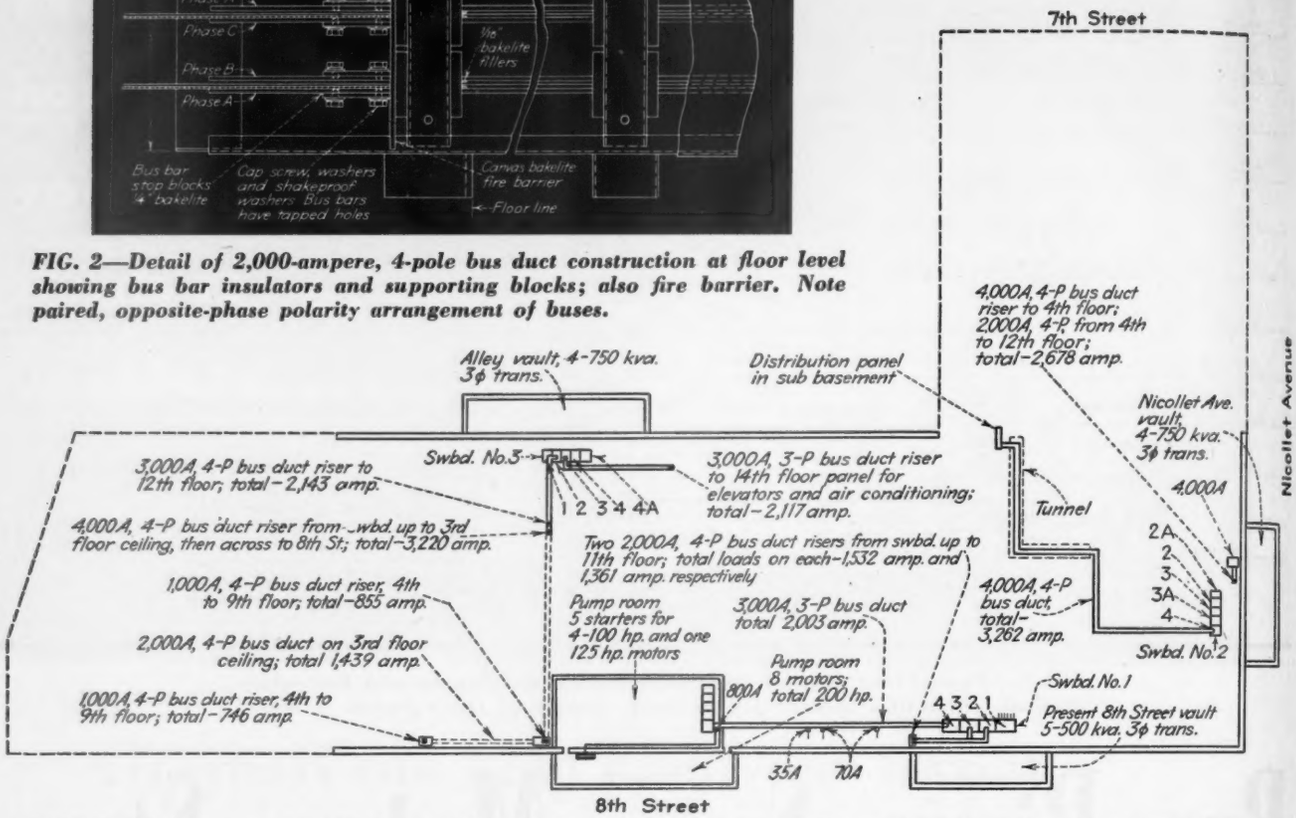


FIG. 3—Sub-basement plan showing relative location of vaults, switchboards and duct risers to serve L-shaped building.

Company, Minneapolis consultants, led to the development of a busduct riser system with special refinements to provide the desired flexibility. Probably one of the first applications to multi-story merchandising structures, this design is essentially a conventional industrial lateral busduct feeder system installed vertically to serve the various floor areas.

Three transformer vaults at different street locations serve the L-shaped building. Primary 13,800-volt power is transformed at these points to 120/208 volts for general 3-phase, 4-wire secondary distribution. One vault contains five 500-kva., 13,800/120/208-volt transformers; the other two each contain four 750-kva. units. Emanating from cubicle type secondary switchboards adjacent to these vaults are the following heavy duty busduct feeders:

Switchboard No. 1 (existing, re-

Quick check on panel load is made by Kvalsten engineer G. L. Gustafson. Hinged door on "tap-off" enclosure simplifies chore; is hiding circuit breakers here.

Floor-level closeup showing Bakelite bus supports and canvas-Bakelite fire barrier on a 2,000-ampere duct riser. Screw cover encloses opening.

vamped)—One 3,000-ampere, 3-pole run to a pump motor center in the sub-basement; two parallel, 2,000-ampere, 4-pole risers up to the 12th floor to serve existing loads enroute.

Switchboard No. 2 (Vault No. 2)—Two 4,000-ampere, 4-pole ducts. One feeds a new sub-basement distribution panel; the other extends up to the 4th floor where, reduced to 2,000-ampere size, it continues to the 12th floor serving existing loads along the way.

Switchboard No. 3 (Vault No. 3)—One 3,000-ampere, 3-pole duct riser to the 14th floor for elevator and air conditioning equipment. One 3,000-ampere, 4-pole riser to the 12th floor to serve existing loads enroute. One 4,000-ampere, 4-pole duct up to the third floor and across the building where it divides at two panel locations into two 1,000-ampere duct risers up to the 8th floor to serve all floors enroute. A 2,000-ampere duct ties the two panels to the heavy feeder.

All switchboards also accommodate numerous existing conduit feeders.

Conduit feeders to distribution panels, either new or existing, extend from the duct risers on each floor. Connection to the duct is made through specially designed "tap-off" units containing two 100-ampere, 3-pole, 250-volt, ITE type ET circuit breakers. Heavier breakers can be used if necessary.

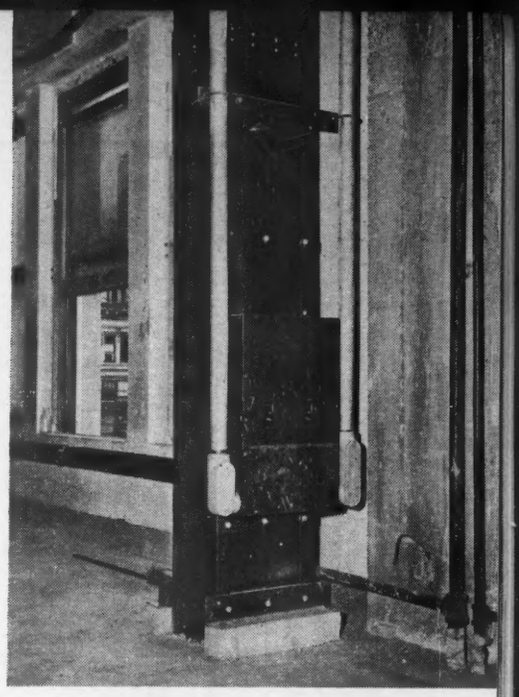
Duct Assembly

The 4,000-ampere, 3-phase, 4-wire, high efficiency, low-voltage duct contains fourteen $\frac{1}{4}$ in. by 4 in. copper busbars in paired opposite phase polarity arrangement; has a $25\frac{3}{4}$ in. by $12\frac{1}{8}$ in. steel enclosure. The 2,000-ampere duct has seven buses (two per phase, one for neutral) in similar arrangement with a 16 in. by $12\frac{1}{8}$ in. enclosure. Other duct sizes are in proportion.

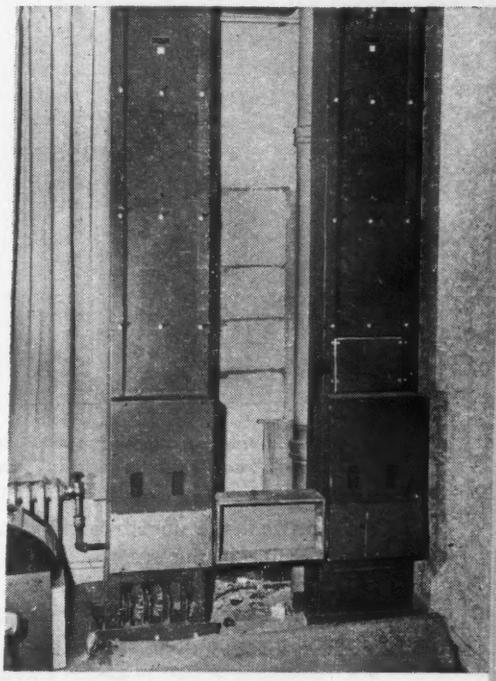
Ventilation is provided by spacer nuts mounted between the overlapping end flanges and side plates of the steel enclosures.

Numerous design problems were introduced by the vertical layout. To distribute the tremendous weight of the duct, special supporting methods were evolved. At each floor level, two 4 in. by 4 in. by $\frac{1}{4}$ in. angle irons were bolted to the sides of the duct. Each angle has two cap screws resting on steel plates on the floor. Once these bolts were adjusted to level the duct, a concrete pad was poured under the angle (thickness depends on finished floor line but never less than one inch) to provide a permanent support.

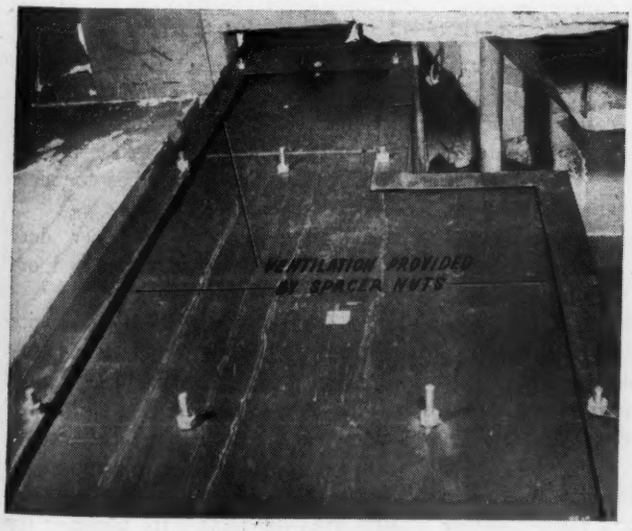
Busbar weight is supported at each floor level by Bakelite stop-blocks equipped with cap screw bolts and shake-proof washers, an integral part of the duct assembly.



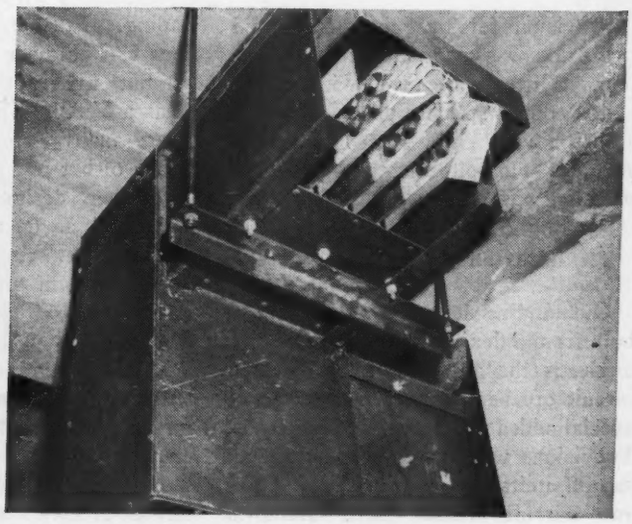
Dual 2-inch panel feeders are connected to 2,000-ampere, 4-pole, busduct riser through special circuit breaker "tap-off" unit. A partition will enclose riser.



Twin risers of 2,000-ampere duct passing through a 6th floor sales area. Panel feeders and circuit breakers not yet installed in "tap-off" enclosures. Arrow shows covered access for spare plug-in unit. Opening at floor line is access to duct "fire-stop" and bus supports.



Reduced from 4,000-ampere to 2,000-ampere capacity at third floor ceiling, this duct riser continues up to 12th floor. Note ventilation space under flanges.



2,000-ampere duct cross-over showing splice plates on busbars. U-shaped "keeper" bar will be removed when run is extended.

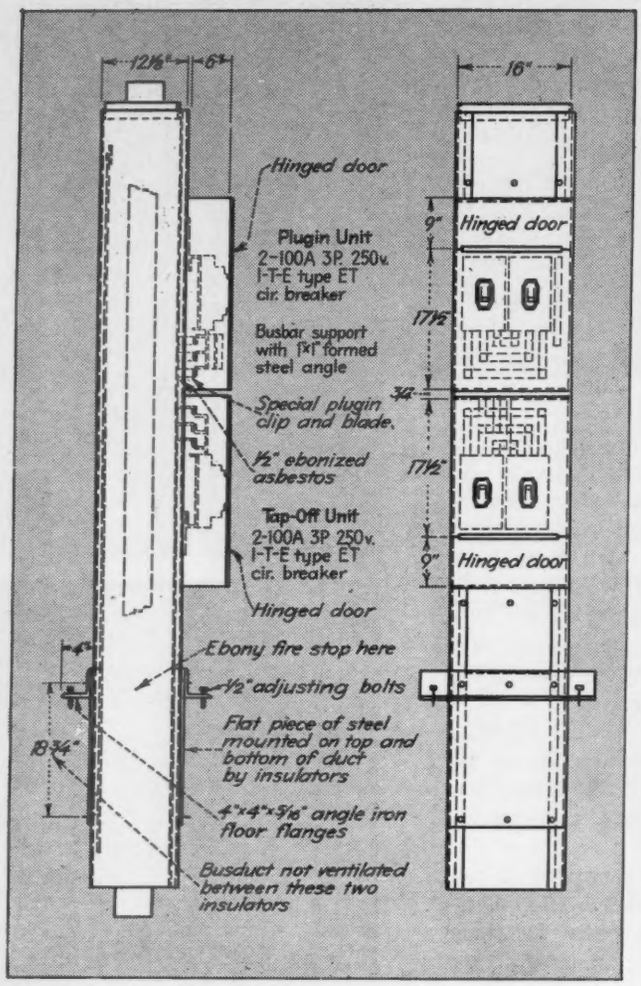
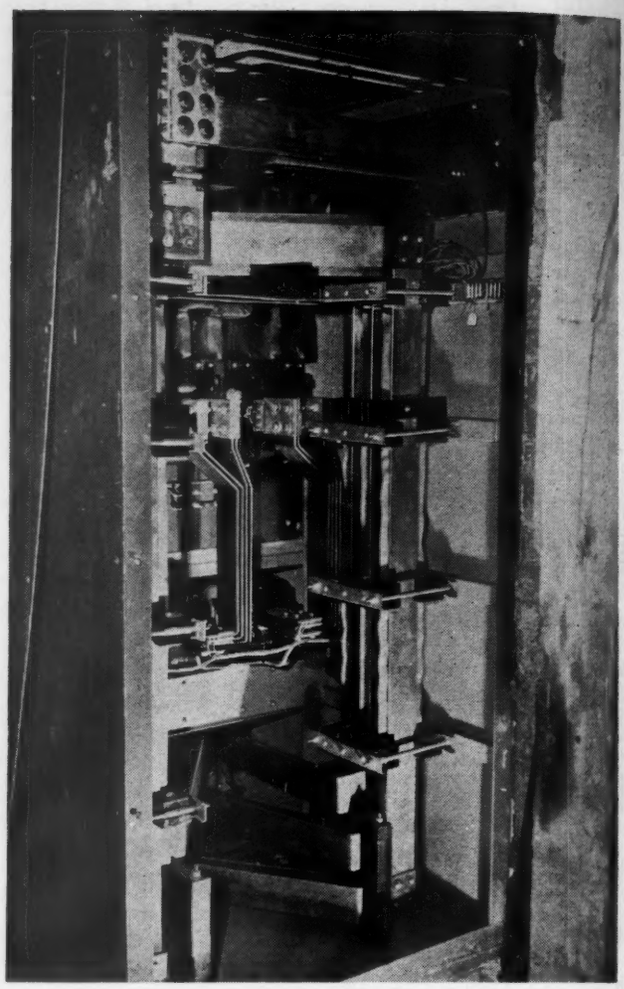


FIG. 4—Detail of 2,000-ampere duct showing mounting of "tap-off" and spare "plug-in" units.



Back of a typical 250-volt, 4,000-ampere switchboard cubicle showing busbar installation.

To prevent the duct from functioning as a flue in the event of a fire on any floor, canvas-Bakelite barriers or "fire stops" were installed around the busbars at each floor line. Duct is not ventilated where it passes through floors.

Provision for bus contraction and expansion was made at each duct section. Splices were made with silver-plated copper splicing plates (8 in. by 4 in.) having eight slotted holes and shoulder stud bolts with cup-type compression washers.

Flexibility and Maintenance Ease

Outstanding feature of this system, both from a flexibility and maintenance angle, is the ability to plug in extra circuit breakers on any floor to serve special added power and lighting loads. Provisions were made above the duct tap-off units for plugging in a duplicate circuit breaker unit. Removal of a Bakelite cover plate exposes four staggered openings in the duct housing. The breaker unit is simply plugged in and bolted to the duct. Suitable sub-feeder or circuit extensions can then be made to whatever temporary or permanent setup is required. The ample spare capacity of the riser ducts permits simultaneous "extra loads" on several floors without danger of overloading. Furthermore, such connections can be made during store hours without interrupting service to the areas affected. This feature, alone, is what many store superintendents dream of but few have.

Another design feature simplifies load checking on any panel connected to the duct risers. Every circuit breaker tap-off and plug-in enclosure is equipped with a hinged door that exposes the sub-feeder cables at the load side of the breakers. The maintenance electrician need only remove four screws, lift the cover and use his clamp-on meter.

Each cubicle feeding a busduct riser has an ammeter with a phase selector switch for a quick check of riser loads.

To simplify branch circuit wiring and assure balanced loads, color coding is used throughout the distribution system. This begins at the cubicles where bus connections at the main breakers were painted in accordance with the following code:

Phase A — Red
Phase B — Yellow
Phase C — Blue

Sub-feeder cable ends were coded likewise at the breaker and panel connections. Red, yellow and blue colored plastic handles on the branch circuit panel toggle switches complete the code scheme.

Careful design of the riser duct system simplified installation and occupies little floor space.

Too frequently the limited capacity and inflexibility of an electrical distribution system restricts the use of lighting as a merchandising technique. The system installed at The Dayton Company permits full utilization of electric power regardless of fluctuating area demands. Its facilities for quick-change and reduced maintenance pave the way to more efficient over-all operation.

Labor Cost Variables — Part II

Factors other than labor units and material price lists which affect job costs.

By Ray Ashley

THERE are many ways in which the various trades can help each other. The ventilating contractor can arrange the delivery of power equipment to fit the program of the electrical contractor. The electrical contractor, in turn, can plan to have the equipment installed and connected as needed. The same conditions apply to all trades. Specifications normally require the electrical contractor to receive all motors and starters at the curb. He is then responsible for them until final connections are made. Such equipment may be delivered far in advance and at a time when the mechanics are all out on the job. Interrupting work to unload the equipment, then storing and protecting it, all takes labor which could have been saved by a little cooperation on the part of some other trade.

There are other ways besides scheduling the work, in which contractors can work together. They can arrange for the use of common scaffolding or hoisting equipment, and at times they can benefit by borrowing each other's tools.

It seems hardly necessary to go into detailed discussion on the labor losses which may result from adverse weather conditions. One does not have to be an estimator to know that open construction projects will be slowed down by cold and stormy weather, and that the progress of any work will be retarded by abnormal heat. Outdoor underground work can be listed among the most hazardous undertakings. Possibilities of having to work with frozen ground can be fairly well anticipated, but rainy seasons are often unpredictable. Starting and stopping jobs is expensive. If a completion date has to be met, the work may have to be carried on under extremely adverse conditions. Heavy rains are likely to require considerable shoring of trench walls, much pumping of water, and difficult working conditions in general.

Careful contractors always have an allowance in their estimates to take care of delays on outside projects. These allowances vary with the time of year, and the possibilities of putting off the work until conditions are favorable.

The Labor Market

Unfortunately, our construction business goes in cycles, and demands for electricians are not uniform. When work is at low ebb there is a surplus of good mechanics, and in boom times not enough well trained men are available. From the standpoint of estimators we are interested in knowing how to make allowances to compensate for variations in the labor market.

Assuming certain facts to be known, we can present a simple problem. Say we have a crew of ten men and the productive efficiency rating of six is 100 percent and of four is 75 percent. The productive efficiency of the crew would be calculated as follows:

$$\begin{array}{rr} 6\times100= & 600 \\ 4\times\ 75= & 300 \\ \hline 10 & 900 \end{array}$$

$$900 \div 10 = 90$$

The rating of the combined crew is 90 percent.

In actual practice the problems met are not so simple to solve. In the first place it is difficult to assign efficiency ratings to either individuals or groups, and in the second place other factors which we have just discussed may obscure the accomplishments of the mechanics.

Most estimators vary their labor units according to the requirements of the times, without segregating the causes of such changes. Labor units established for certain construction periods (usually the more favorable ones) are supposed to represent 100 percent productive efficiency. If the general trend of costs is upward or downward, a multiplier is used to compensate for the change.

The labor units established in 1938 are used as a base by many contractors. Conditions were very favorable at that time. The proper materials and equipment were readily available, there were sufficient mechanics to permit selecting men best adapted to the work at hand, and other trades were able to offer good cooperation.

In 1946 approximately 30 percent was added to the 1938 units in order to make jobs pay out. Many shortsighted people had the erroneous idea that the labor market was responsible for the whole of this 30 percent increase. They not only blamed the newer mechanics, but contended that the regular men were letting down. This was indeed unfair to many of the older mechanics.

A listing of the actual causes of this increased cost of labor, together with their effects would be approximately as follows:

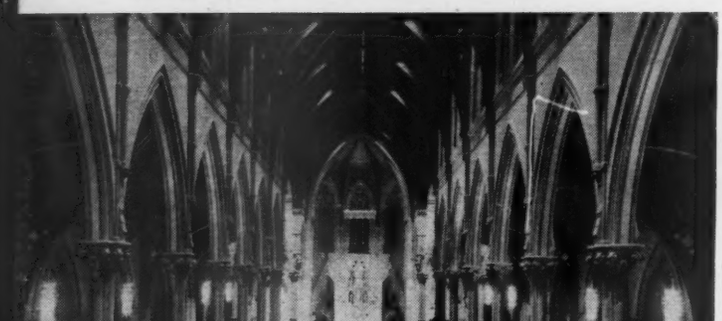
Delayed and untimely deliveries of materials	7%
Lack of cooperation of other trades	5%
General confusion on the jobs	3%
Labor market	15%
Total	30%

No doubt part of the 15 percent (labor market) was due to indifference on the part of some of the mechanics. When work is plentiful there are always those who will take advantage of the times, and the turnover of mechanics on the jobs is much greater than in duller times. We must not, however, lose sight of the losses due to the other items listed which contractors experienced in 1946. Material deliveries were bad, the work of other trades was spasmodic, and the general confusion which existed had a tendency to slow down the work of all trades.

(Continued on page 115)

CHURCH LIGHTING

A discussion of fundamental factors and principles involved in effective lighting for the house of worship.



General lighting from sixteen harmonizing artistic lanterns is supplemented with direct light from 36 750-watt downlights recessed in the 100-foot high ceiling of this church. Illumination in side aisles averages four footcandles, and in nave eight footcandles. Altar is highlighted to 18 footcandles average. Note that ceiling is kept in darkness to accentuate loftiness. Cathedral of the Holy Cross, Boston.

Gothic lanterns provide illumination in the nave of this narrow Gothic church, while concealed reflectors light the sanctuary. Lanterns each contain three circuits, one for indirect lighting reflectors, one for a direct lighting reflector, and one for small wattage lamps used to softly light the amber glass panels in the lantern body. North Austin Church, Chicago, Illinois.

CHURCH lighting is a specialized field. It is not, however, a difficult one. Knowledge of good lighting principles, plus an understanding of church rituals and architectural conformity between the church structure and lighting units, are the more important factors on which proper lighting for the church are based.

Church lighting design procedure cannot logically be standardized as has been done in other fields. Church structures vary widely in type, and artistic effects play an important part. Churches are the visions, in wood, metal and stone, of our great architectural geniuses, representing the spirit of the age in which built. Compared with the history of religious edifices, artificial light from electric power is relatively new. This makes it doubly important that the lighting engineer cooperate fully with the architect, and

An excellent example of relighting. Original installation consisted of 25 watt bare lamps in rosettes located in all arches, now capped with ornaments, and by bare lamps in multiple arm clusters around capitals on columns. New installation uses reflectors at base of arches above columns and from cove above. Illumination varies between eight and ten footcandles throughout. Note uniformity and evenness of lighting. Chapel, St. Mary's Industrial School, Baltimore, Md.

G TECHNIQUES

By Berlon C. Cooper

Floodlighting is one means of attracting attention to the church edifice. The dignity of tall Gothic spires can be accentuated, or the beauty of the church building enhanced, with lighting, as shown at right. Other methods sometimes used include floodlighting of stained glass windows from within, installation of an illuminated fixed or revolving cross, and use of electric signs.

that both give lighting most careful consideration. The lighting engineer who specializes in church illumination must recognize the importance of getting into the spirit of the problem, and of making a careful study of the artistic, symbolic and practical features involved. In this way, and this way only, can the imposing character of light be made proper use of in the religious ritual and church building.

From the religious service standpoint, there are in general two classes of churches. One is the liturgical or ritualistic, with a place for an altar, in which religious ceremony takes precedence over the speaker. The altar or sanctuary in this type church is flooded with light to center the attention of the congregation upon the richest and most symbolic part of the service and interior. Subdued illumination is normally provided here for the congregation.

The other class of church is the conventicle or evangelical type, in which a general illumination adequate for reading comfortably is provided throughout the auditorium. The speaker becomes the center of interest in this type church, and is frequently accentuated by special lighting, so that he may be seen and heard with ease.

In approaching the solution to any church lighting problem, there are certain lighting fundamentals which should be kept in mind, regardless of the size or architecture of the building, or of the ritual followed by the church. The lighting should be comfortable. It should be adequate in quantity and quality for the purpose for which intended. All light sources should be concealed or well shielded to prevent glare. The lighting system should be efficient, and brightness contrasts should be held to a minimum in the normal field of view.

Also, lighting should conform to the architectural treatment, and when luminaires are used, these should harmonize with the period design of the architecture. Symbolic features for any particular creed should be made to supplement the architectural treatment with light to create a reverent atmosphere, for the psychological effect upon the audience.

With the advent of gas and electricity for lighting, hanging chandeliers and lanterns, wrought of metal and embellished with glass were early adopted for the lighting of churches. These usually ornate units, produced by skilled metal craftsmen, were suspended by long chains quite low over the pews to facilitate maintenance and to increase efficiency. Introduction of larger size electric lamps, and their adaptation to these hanging lanterns in an effort to satisfy the demand for more light introduced glare. Lanterns were then suspended higher from the

Dignity of the cathedral atmosphere was retained, and the feeling of height and spaciousness maintained in this church, by keeping the high beamed roof truss ceiling dark and by providing light without fixtures. A unique method was used to provide indirect lighting from the wall area by projecting light from reflectors concealed in the wall opposite. Other lighting includes inconspicuous light for stations of the cross and accent light on the altar. St. Joseph's Cathedral, San Diego, California.

Temple Emanu-El, New York City, uses a modified Byzantine style of architecture. A uniform distribution of direct light from three rows of reflectors concealed in the ceiling provide suitable reading light at the plane of the pews, keeping the ceiling and side walls subdued. Two banks of concentrated type reflectors in the ceiling provide brilliant graduated lighting in the chancel. The entire lighting system is dimmer controlled.

Soft restful illumination is provided throughout the auditorium of this Conventicle type church by means of reflectors concealed in wall urns. This simulates cove lighting in an area where no cove exists. The Gothic treatment of the urn exterior adds a decorative and symbolic touch to an otherwise rather plain auditorium type interior. Churches of this type may also be lighted effectively with suspended indirect or semi-indirect luminaires, or with reflectors concealed in coves or window ledges. Structural details on each church will usually control to large extent the exact method best suited for that church. Roxborough Baptist Church, Philadelphia, Pa.

floor to remove the bright sources from the field of vision. The conventional layout for location of lanterns, particularly in the Gothic type churches of the cruciform plan, has become more or less standardized on two rows of lanterns, located slightly inside the two rows of columns. Spacing lengthwise should equal the architectural bay spacing, with the lantern located in the center of the bay. Lanterns are also appropriate for Roman, Modern, etc., styles of architecture, with the shape and decorative motif conforming. Early type lanterns were of a direct or diffusing type. Later practice has been to locate a perforated metal reflector behind the lamp on the side of the lantern viewed by the congregation, or to use denser type glass panels on the side of the lantern opposite the altar or sanctuary. Many lanterns have also been used which have components of direct and indirect lighting, some light being reflected downward, some to the ceiling, and the glass panels in the lantern being illuminated by small wattage lamps for effect only. Such lanterns, when wired with three-circuit control, offer maximum flexibility to the lighting result.

Indirect lighting is suitable for many churches, especially those of the evangelical type. It can be obtained in many ways; such as by suspended luminous bowl indirect luminaires, by reflectors concealed in coves, wall urns, pedestals on balcony railing, window ledges, and other similar architectural elements. Reflectors were recessed in the walls of one church to project light to the opposite wall, which provided indirect light from the wall areas only, leaving the lofty ceiling in semi-darkness, as desired.

Quite often it is impossible to obtain the desired illumination intensity for a church from lanterns or luminaires without excessive brightness of the units, or making the units too large to be in good architectural proportion. In such instances, reflectors can usually be recessed in the ceiling or combined with architectural motifs to provide added light throughout the church. It is desirable to provide dimmer control for such equipment so that illumination can be increased or decreased gradually. This prevents the congregation from being conscious of the change, or distracted from the service.

Sanctuary lighting is particularly important in ritualistic churches. In general it is accomplished with reflectors concealed behind the sanctuary arch, and by projector type units or downlights recessed in the ceiling, behind beams, or in the canopy over the mensa. Altars are effectively lighted when projectors are installed so that light falls upon the ornamentation from an angle of about 45 degrees.

Local light on a lecturn produces unnatural facial expressions of the speaker, and should not be used. A projector installed in the ceiling or on the side so that a beam of light is directed to the speaker from an angle of about 45 degrees overhead is desirable.

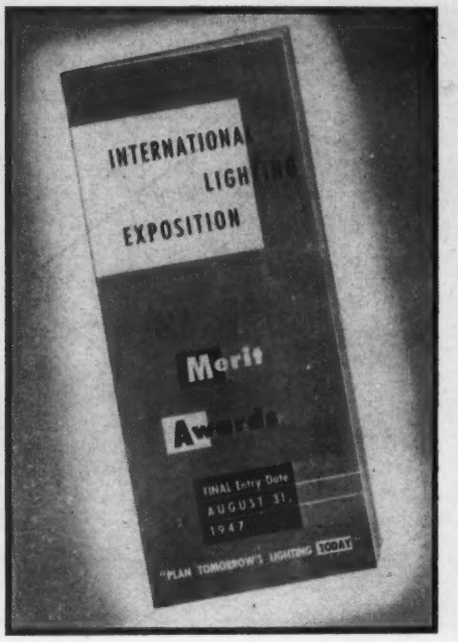
Departmental rooms in the church, such as class rooms, baptistry, club rooms, study and social rooms, etc., should be treated as utilitarian areas and adequate light of proper quality and flexibility provided. Luminaires for these areas in monumental type churches should also harmonize architecturally with the building.

The beauty of stained glass windows can be brought out for night services by lighting them from the exterior. They can be used to attract attention to the church nightly by lighting them from within. Some of the richest examples of modern art are represented in these windows, and lighting offers an excellent medium to display their symbolic beauty to the passing public.

Floodlighting can be used to bring out the beauty of a church building, especially those having tall spires, or architectural features visible at a distance. It is a subtle form of advertising, or of establishing location of the church to all who pass. Exterior bulletin boards should also be lighted from concealed sources.

AWARDS for LIGHTING

Preview. R. W. Staud, Vice Chairman, and E. C. Huercamp, Chairman of the Exposition operating committee, with an enlarged copy of the Merit Award Certificate to be given with $100 to the 12 best entries in the competition.



How to enter. Send for rule book and official entry application. Address Merit Award Committee, 2nd International Lighting Exposition, 326 West Madison Street, Room 818, Chicago, 6, Illinois. Deadline August 31.

International Lighting Exposition invites lighting plans in merit award competition.

HOW good are your lighting jobs? Are any of them outstanding examples of planned lighting application? If they are, submit the plan and data to the merit award competition sponsored by the 2nd International Lighting Exposition and the Industrial and Commercial Lighting Equipment Section of NEMA.

To direct industry-wide attention to lighting achievement, to provide a clearing house for the exchange of meritorious lighting ideas, and to stimulate thinking along similar lines among the thousands who will attend the lighting exposition this fall, the sponsors have provided this opportunity for nationwide recognition of outstanding lighting achievement.

The contest is open to owners, lighting specialists, engineers, or other employees of electrical contracting companies, electric light and power companies, electrical wholesalers, and architectural and consulting engineering firms who have had a part in designing, planning, selling, or installation of the job to be entered.

There are four separate competitions, and one for each of the following groups:

a. Electrical Contractors
b. Utility Lighting and Power Representatives
c. Architects and Consulting Engineers
d. Wholesalers' Lighting Specialists and Salesmen

Judging will be intra-group—that is, a submittal by an electrical contractor will compete with only those of other electrical contractors, etc., and awards will be decided accordingly. In addition, where the installation is the cooperative work of two or more men of the above classifications, the entry may be submitted by the two or more involved as a joint entry and entered in one or more of the applicable classifications.

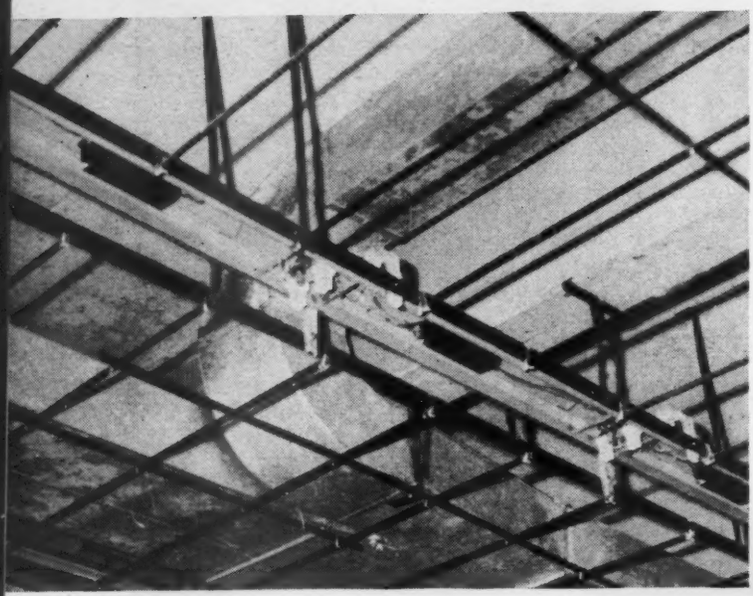
Three Gold Seal Merit Awards will be given in each of the four classifications. From all submittals in each group, three entries will be selected by the judges, and these will be awarded a special Gold Seal Certificate which comes with a cash award of $100 each, a total of twelve awards, totalling $1200. Thus, there will be three winners of $100 cash prizes who will be in the electrical contracting group, three $100 cash prizes in the utility lighting group, three in the architectural and consulting engineering group, and three in the wholesaling group.

To enter the competition write to the Merit Award Committee, 2nd International Lighting Exposition and Conference, 326 West Madison Street, Room 818, Chicago 6, Illinois, for the official rules and entry blank.

In the preparation of entries, the Committee allows wide freedom as to the presentation. A number of suggestions are offered, however, to assist in the preparation of reports.

[Continued on page 162]

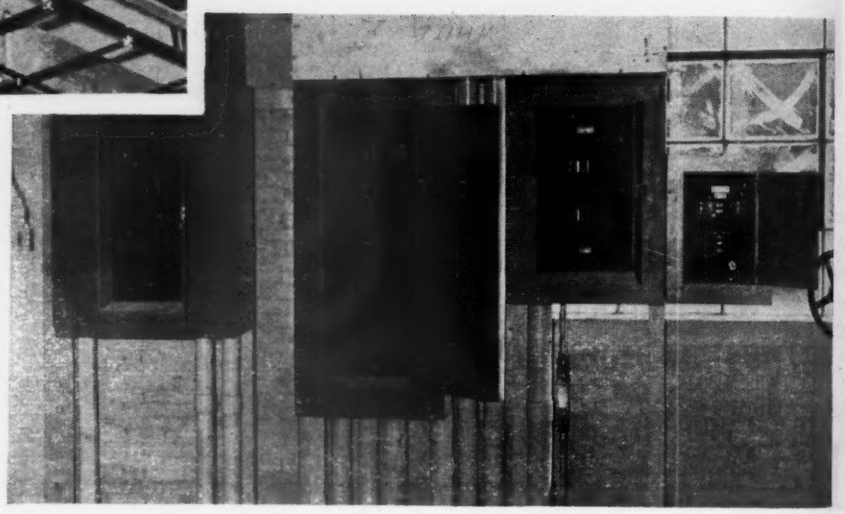
Laboratory Distribution



Three basic light sources, two media for power distribution, multi-voltage testing facilities and explosion-proof equipment are incorporated in this unusual wiring job engineered by Wigton-Abbott and installed by Edward J. White.

By Hugh P. Scott

Steel framework, suspended from the flanges of structural I-beams, supports both acoustical tile ceiling and lighting troffers. Air conditioning ducts, separately suspended, will be concealed by hung ceiling.



Electrical service for the main building is brought by underground feeders to bank of dead-front distribution panels and then is conducted to feeder and plug-in bus-duct, underfloor wiring troughs and load centers for local power, receptacle and lighting circuits.

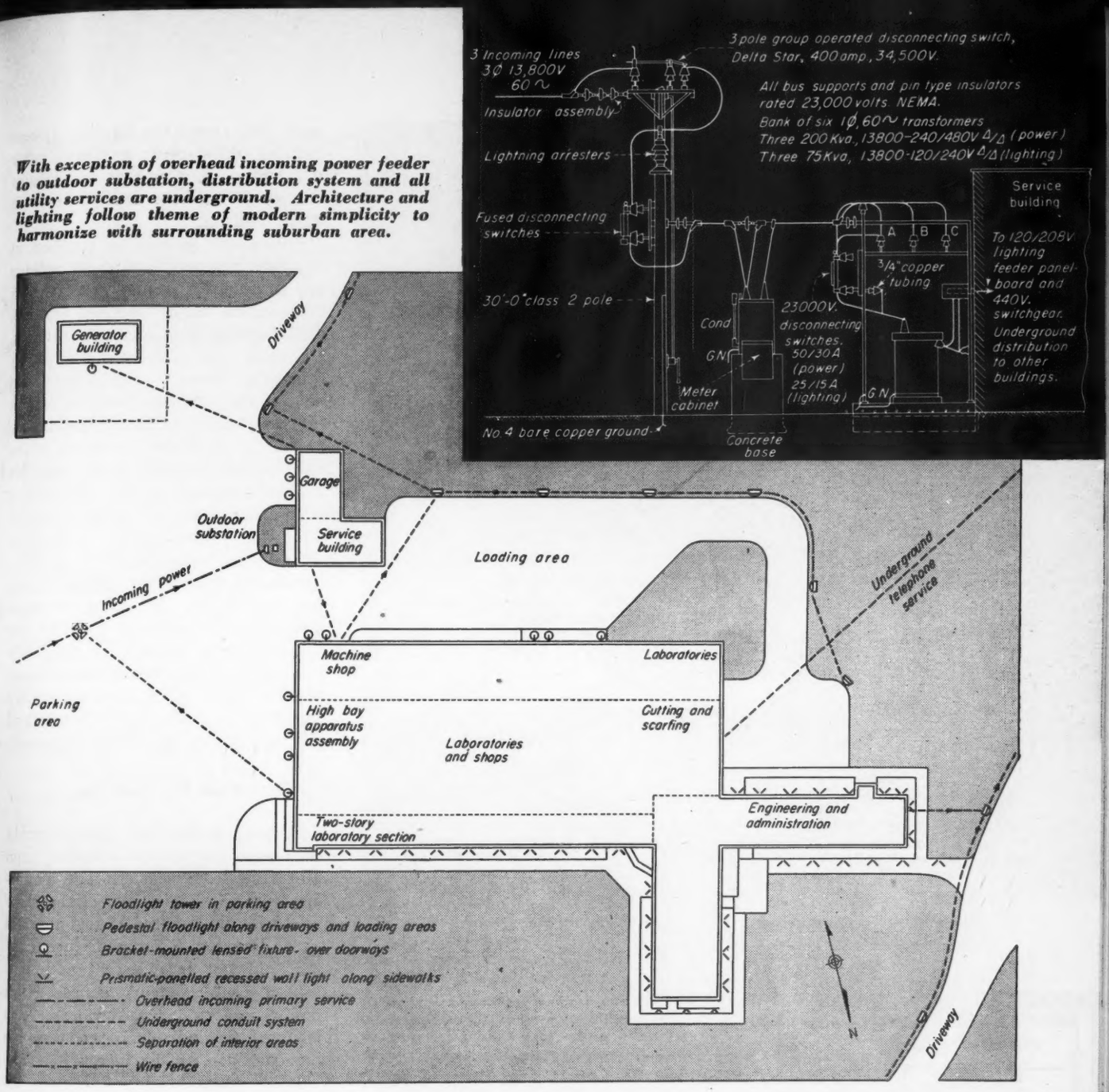
THE ever-expanding scope of modern electrical know-how is effecting constant changes and improvements in both engineering and construction techniques. This is forcefully apparent in the design and methods practiced in erecting the recently-completed research laboratories for the Air Reduction Sales Company. To satisfy the complexity of laboratory requirements, three basic light sources are utilized (fluorescent, incandescent and mercury vapor), two media for power distribution are employed (bus duct and cable), specific areas are served with multi-voltage receptacles and protected by explosion- and waterproof equipment. Each laboratory, shop and office has been treated as a distinct problem in order to secure the most effective application of both power and light.

Designed and erected to improve Air Reduction products through progressive engineering, research and pre-testing, the plant is a combination of multi-purpose shops, laboratories, engineering areas and administration offices. In plan, a rectangular acre of shops and laboratories is connected at a common junction to two, two-story administration wings. Service, garage and generator buildings are located to the southeast of the main unit. Located in a semi-residential section of New Providence, New Jersey, the buildings have been designed to harmonize with the neighborhood. Functionalism and modern simplicity have been combined architecturally in the creation of both administration and shop sections. Roof copings are raised to conceal ventilation equipment. Sweeping driveways lead to loading platforms and parking areas. Driveways and walks are illuminated by weatherproofed wall-recessed or low pedestal - mounted flood - lensed luminaires. Except in the parking area, all distribution feeders and utility services are buried. Brick veneer and the liberal utilization of glass furthers the exterior impressiveness of the research development.

Distribution

Primary service, 13,800 volts, 3 phase, 60 cycle, supplied by the Jersey Central Power and Light Company, is airborne to a single structural steel tower, centered in the parking area, and thence to an outdoor substation where it is stepped down through six single-phase transformers to 480 v. for power (three units) and 120/208 v. for receptacles and lighting (three

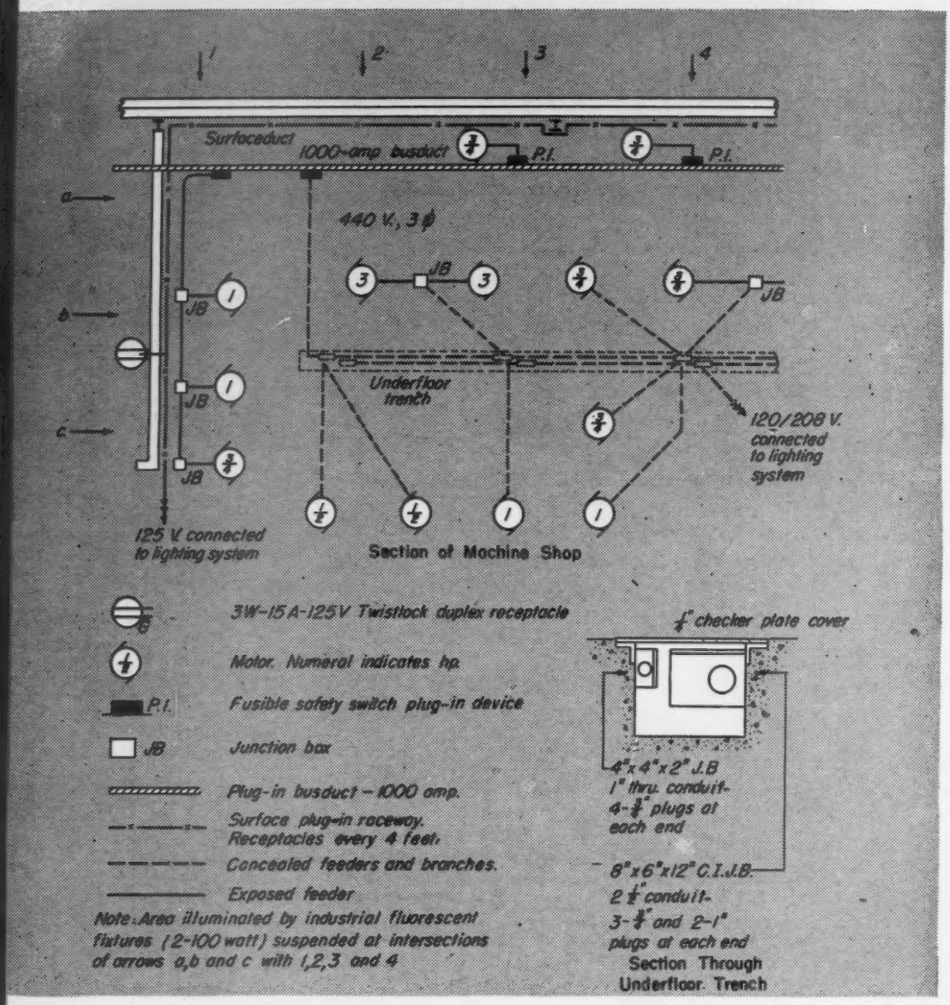
With exception of overhead incoming power feeder to outdoor substation, distribution system and all utility services are underground. Architecture and lighting follow theme of modern simplicity to harmonize with surrounding suburban area.

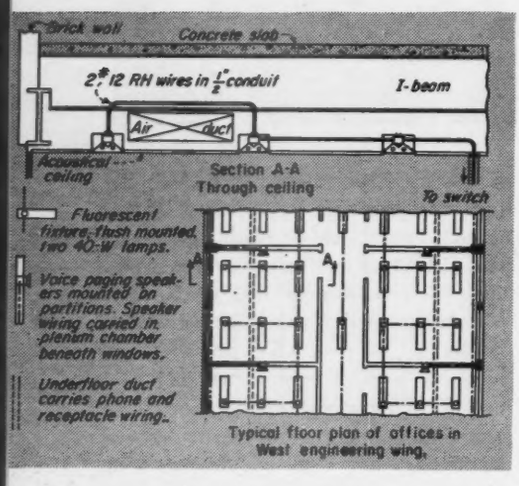


units). Switchgear and panelboards are located inside the adjacent Service Building, underground conduit connecting this center with the other buildings in the development. Powered directly from these main panels is the equipment housed in the Service Building: boiler control panels, dryer, condensate return and water pumps, preheater and air compressors.

The main building, with separate areas for laboratories, shops, engineering and administration, calls for a variety of services. High bay laboratory space of welded-beam construction is devoted to cutting and scarfing, flame testing and apparatus assembly. Bordering this high bay space along the southern side is a machine shop, storage area, X-ray room, and laboratories for welding, cylinder testing and oxygen control. Directly north is a two-story section containing additional laboratories: regulator, generator, electrical and physical testing, apparatus, chemical, heat treating, rough grinding and microscopy, a photographic department and instrument room.

This combination of areas is primarily powered through 1000- and 400-amp. plug-in busduct. Connection of ducts to distribution panels is through either low reactance feeder duct or feeder cable. Served from this bus system are approximately 80 motors operating grinders, drills, shapers, lathes, presses, shears, abrasive wheels, sanders, saws and coil winders. Machines located adjacent to ducts are connected by overhead branch circuits while free-standing equipment in open floor areas is served from waterproof, cast iron floor junction boxes tapping secondary trench-laid feeders. All circuits are protected by individual fused switches and breaker equipment. Also served by bus duct are power receptacles (3 wire, 4 pole, 480 v., 60- and 100-amp. a-c), X-ray equipment, ovens, rectifiers and m-g sets, furnaces and physical testing equipment. Conventional cable-conduit distribution feeds unit heaters, air conditioning equipment and roof fans. Crane-powering trolley wires extend the length of the building along the south side of the high bay area. Twenty-one test stations, located in various shop areas, provide air, gas and electric facilities. At each station, single-phase 15 a. 115 v., 50 a. 120 v., 60 a. 440 v. and three phase 440 v. a-c is available. Portable rectifiers and transformers supply the infrequent demand for d-c and three phase 220 v. a-c.





Multi-voltage distribution system in machine shop area utilizes surface-duct, underfloor trench feeders, receptacle circuits and busduct with plugin devices. Industrial fluorescent fixtures, each containing two 100-watt 3500-degree white lamps, illuminate this section.

Prismatic-lensed fluorescent fixtures are recessed into acoustical ceilings of the engineering offices. Phone and receptacle wiring is carried in floor ducts. Wiring channels in plenum chambers beneath windows carry circuits feeding modulated paging speakers that are mounted on movable partitions.

With the exception of printing presses, the office section is served solely by 208/120 v. current. Distribution in this section is by galvanized rigid conduit concealed in floor slabs and installed above suspended acoustical ceilings, in raceways located in the hollow bases and vertical columns of movable steel office partitions, and in continuous metal heating enclosures beneath the steel casement windows. The lighting and receptacle load of 259 kw. is connected through 379 branch circuits to twenty, three-phase, 4 wire 208/120 volt load centers. The minimum size of wire utilized for distribution is number 12 gage.

Designed for widely dissimilar purposes and areas, the lighting system includes fluorescent, mercury vapor and incandescent sources and ranges in application from totally direct to totally indirect.

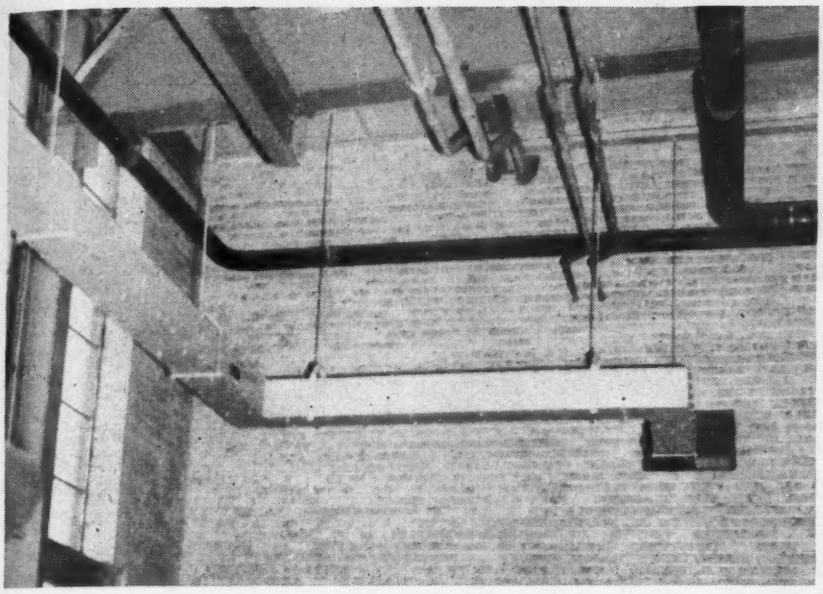
Fluorescent lighting is installed in all offices and corridors where ceilings are suspended and in some areas of the machine shop. Recessed troffers, flush mounted with acoustical ceilings, are faced with wide-spread diffusing prismatic lenses. Pendant-mounted units in the administration area utilize eggcrate louvres in fixture assemblies. Industrial open-end porcelain-enameled fixtures, installed in the machine shop, are chain suspended. Depending upon location, troffers and suspended units contain single lamps in the corridors, or groups of two in the administration and engineering offices, or four for the library. Mounting arrangements are in continuous runs for the drafting room as well as geometric groupings and single-unit installations in other areas. All fixtures are rigidly supported and adjusted for height and alignment with plumb-bob accuracy.

High Bay Lighting

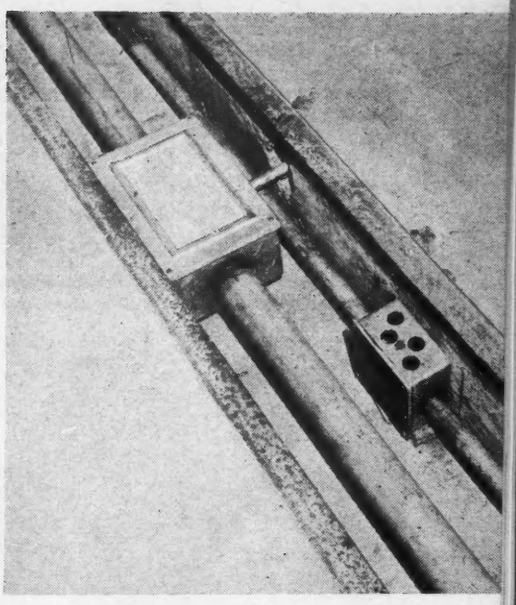
Fixtures in the high bay assembly shop area are pendant-mounted from ⅜-inch messenger cables. The mounting height is 22 feet above the floor level with units spaced 15 feet apart in either direction. Alternate fixtures contain 750-watt incandescent and 400-watt Type H mercury lamps. High power factor transformers are mounted on individual pendants for the operation of the mercury lamps. The mounting height of 22 feet insures clearance of traveling cranes yet permits relamping from the cranes.

Incandescent lamps are used in RLM pendant reflectors (welding laboratory, air conditioning room), in prismatic lensed fixtures (in locker rooms, stairways) and in all exit signs. Exit signs (green translucent letters on opaque fields) and stairway lights are separately circuited.

Exterior lighting continues the theme of selecting the most effective application for each specific lighting problem. Weatherproof 100-watt fixtures, with prismatic panels to direct light downward towards sidewalks, are flush-mounted into building walls beneath window sills. Walks are safely lighted without the creation of glare. Along driveways and around loading areas, low concrete pedestals (less than 3½-feet overall height above grade) house 100- and 200-watt lamps behind



Plug-in bus-duct (1000-amp., 440-volt, 3-phase) is offset when passing through brick wall to by-pass explosion-proofed oxygen control room. All conductors entering or passing through this area are carried in rigid steel conduit sealed into walls.



Equipment located in open bay shop areas is serviced through floor trenches. Junction boxes carry 440-volt, 3-phase and 120/208-volt current.

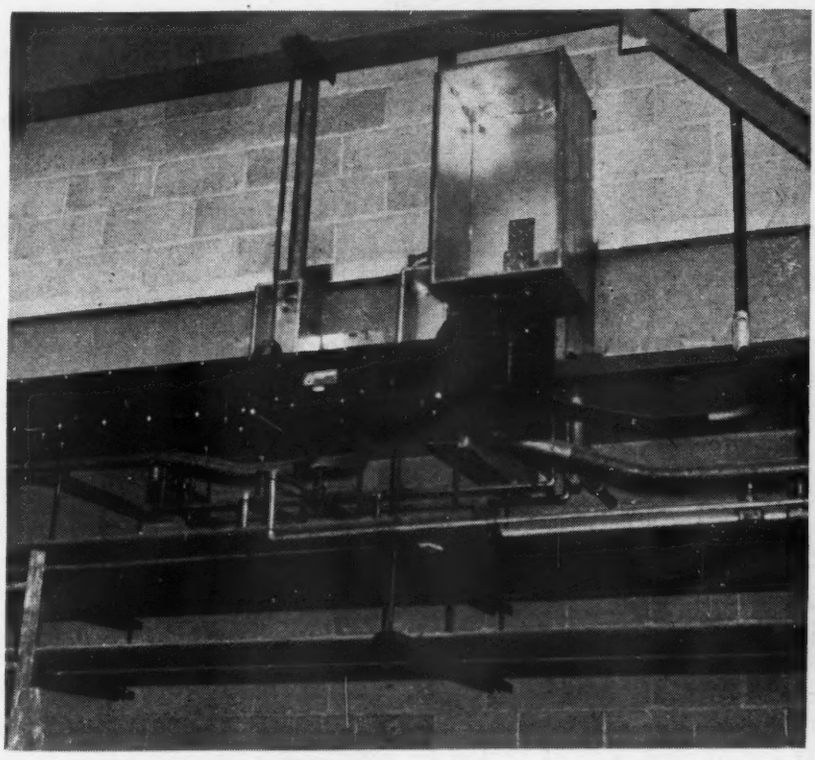
horizontal-spread floodlight lenses. Brackets above shop, garage and generator building doors mount Holophane-lensed fixtures with 200-watt lamps.

In lighting the parking area, use is made of the centrally-located steel tower that supports the incoming primary power service. Four 750-watt open floodlights, complete with lowering attachments and special mounting brackets, are mounted on this tower and direct light to the four corners of the area.

All exterior lighting is controlled from interior control panels. Feeder service to these outdoor units is through underground conduit.

Paging System

Three voice-paging loud speakers in the open shop areas, one medium tone speaker in the roof-located cafeteria, and 66 small soft-toned reproducers, located on the walls of individual offices, are operated from the telephone booth adjacent to the entrance foyer. Four separate channels permit paging in any one desired area or any combination of areas in the plant. The four paging areas segregate the shops, drafting room and administrative offices, cafeteria and west-wing engineering offices, laboratories and east-wing engineering offices. Tone signal control regulates modulation. Transmission is through a desk-stand microphone unit on the main telephone switchboard.



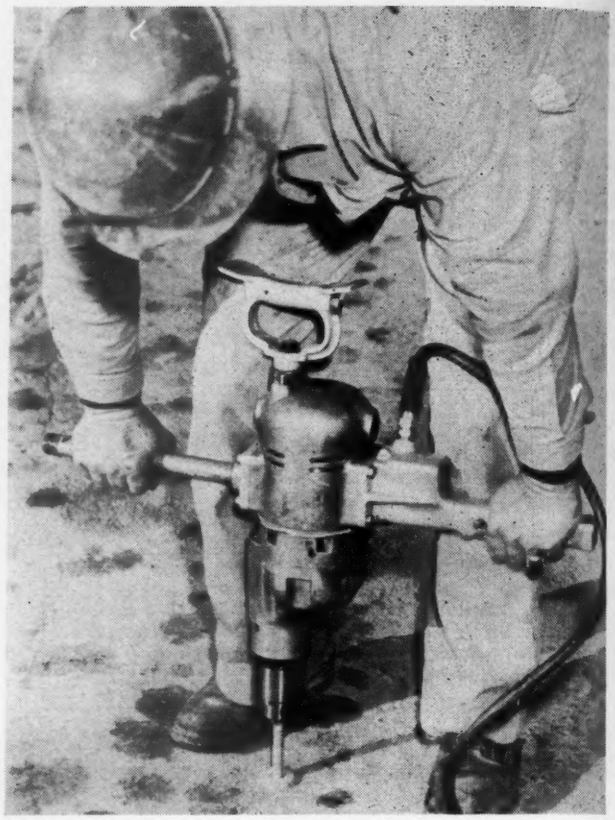
Construction view shows busduct and conduit prior to pulling in cables. Proximity of feeders to other required laboratory services (water, air, gas, steam) complicated electrical routing and connecting.

The completed project represents the utilization of new conceptions of electrical service in the laboratory field and demonstrates new installation techniques and construction methods. With engineering and shop facilities in close proximity with laboratories, production efficiencies will be at maximum through simultaneous design and testing.

The electrical distribution, loud speaker and telephone conduit systems, substation installation and lighting represent contracts exceeding $100,000. The project was designed, engineered and constructed by the Wigton-Abbott Corporation, Plainfield, N. J. The electrical installation was made by Edward J. White, Newark, N. J.

Carbide masonry drills are made up of a steel shank to which is attached a cutting blade of carbide metal, hardest of all man-made metals. This tool permits drilling holes through construction material with portable electric drills or hand braces.

Put pressure on masonry drills when drilling with them. The more pressure, the better they work.



How To Use Carbide Drills

How to get most out of carbide masonry drills through proper use and maintenance.

By Harold York
Development Engineer
Carboloy Company, Inc., Detroit, Mich.

GENERAL adoption of carbide tipped masonry drills for drilling holes in concrete, brick, tile, marble, slate, plastics, and many other materials, has brought with it a need for a better understanding of how to get the most out of this versatile tool. The following information—compiled from controlled experimental tests and from field reports—should help in getting maximum performance and service life.

Carboloy masonry drills are made up of a steel shank into which is inserted and brazed the cutting blade of solid cemented carbide (see Fig. 1). Inasmuch as carbide is many times harder than any material that may have to be drilled in ordinary production and maintenance work (Carboloy cemented carbide metal approaches the diamond in hardness), the drill is capable of cutting faster, smoother, and more accurate holes than can the conventional star - drill - and - hammer combination.

All ordinary types of construction materials can be drilled quickly and cleanly with the carbide masonry drill. In fact, reports on its uses indicate that this drill is rapidly becoming a sort of "universal" tool, by electricians, plumbers, and maintenance men, for drilling holes into all kinds of walls and floors.

The conventional uses for these drills are for drilling holes in concrete, for anchor bolts for such things as machine installations, fastening seats to theater floors, pipe straps, etc.

In addition to these many "routine" uses, the masonry drill is currently being used effectively on many unusual jobs.

It is interesting to note that perhaps the deepest holes made by Carboloy masonry drills to date are those produced by some special elevator installation work. Here, holes 24" deep were drilled through a combination of brick and concrete. In this instance, the drill shank was not only extended but was also specially fluted to facilitate the removal of dust from the extra deep holes.

How To Use

Carboloy masonry drills have been designed for use in any rotary portable drill or hand brace. The drills are also being used to good advantage in drill presses. They are not recommended for use in hammer type percussion drills due to the chance of chipping the extremely hard cutting edge.

All ordinary speeds of electric porta-

[Continued on page 164]

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

Practical Methods

Column Panels Decentralize Control

WIRING

Structural features of the new administration and engineering building of the Briggs Manufacturing Company in Detroit precluded the use of conventional wall-mounted lighting distribution panels. Because of the saw-tooth roof on the second floor, installed to provide north light for the engineering areas, lighting branch circuits could not be installed at right angles to the east-west bays.

Brooker Electric Company, Inc., Detroit electrical contractors on the project, solved the problem by decentralizing lighting control in numerous 18 to 28-circuit panels mounted in the area columns. The narrow panels (8½-in. wide and about 60-in. tall, including 200-ampere, single phase main breaker at bottom) were installed flush in the octagonal steel shell surrounding the column proper. Where necessary, local control switches were also mounted flush in this shell which also acts as an air duct for the heating and cooling system.

By installing a panel in one column per bay, branch circuit conduits could easily be run parallel to the saw-tooth construction. When painted to match the column decorative scheme, the panel trim and doors are barely discernible.

Such decentralization of control also has the advantage of localizing outages should trouble occur. Only the area served by a specific column panel would be affected should a feeder go out.

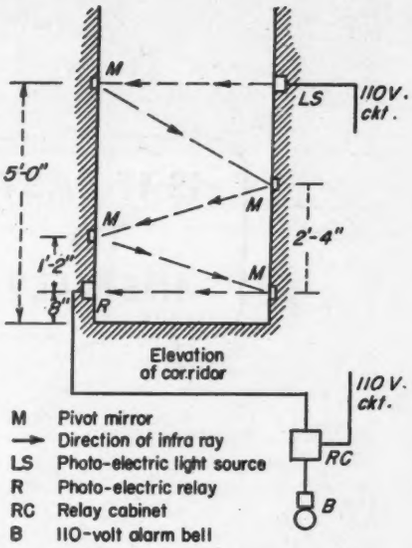


Photo-electric light source activates bell-ringing relay when infra-ray is interrupted by person using emergency exit. Opaque surfaced mirrors reflect beam across corridor at five levels to produce a barrier of light. Installation operates at 110 volts.

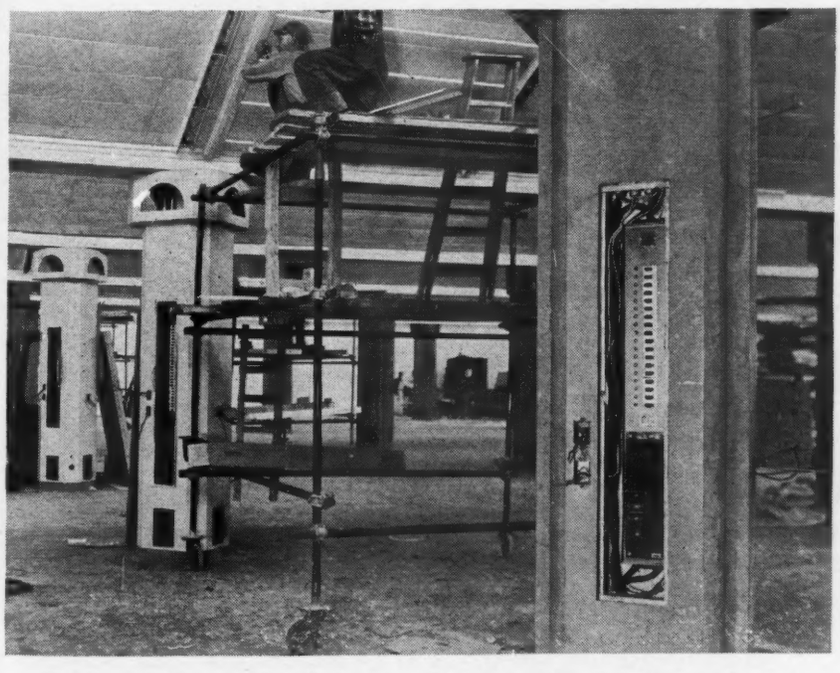
Photo-Cell Guards Exit

SAFETY

The installation of wall-recessed photo-electric alarm equipment automatically summons a guard whenever someone uses the fire-tower emergency stairways of Lane Bryant's modern New York store. Since merchandise is sometimes removed illegally by way of fire towers, this protective system should prove to be a strong deterrent to shoplifters.

A photo-electric light source bars the stairway corridor with a beam of light which is reflected by a series of pivot mirrors to a photo-electric relay. When the beam is interrupted, the relay activates a 110-volt alarm bell located on a lower floor and a guard at the street exit is alerted when the photocell barrier is passed. Unauthorized persons, using this route for leaving the building, receive no warning of the barrier's existence since the light beam is screened through an infra-ray filter and is invisible to the eye. Even should the location of the beam be known, it would be impossible to jump above the beam or crawl beneath it since the pivot mirrors reflect the light across the corridor at five elevations ranging from eight inches to five feet above the corridor floor.

The alarm equipment includes the light source, photo-electric tube holder, lenses, infra-ray filter, transformer, relay, special cap and mirrors. Operation is from a 110 volt circuit. Recessed mirrors are as inconspicuous as



Numerous column distribution panels decentralize lighting control at Briggs new engineering building. Scheme also localizes effects of feeder outages.

IT SURELY IS . . . IT'S

HOLDENLINE

CHAN'L-RUN

HOLDENLINE CO.

Pioneers in Fluorescent

2301 SCRANTON RD., CLEVELAND 13, OHIO

the light beam, being opaque surfaced "Evabrite" units. Each mirror, of ¼-inch plate, measures 3½ by 4⅛ inches. The equipment is recessed in the wall construction and mounted in special heavy gauge back boxes with flush, cylinder locking, hinged doors.

This protective light barrier was incorporated in the electrical specifications prepared for Lane Bryant by Consulting Engineer Edward E. Ashley, New York City.

Rugged Service With Fiberglas

MAINTENANCE

An induction heater, employed by Peerless Molded Plastics of Toledo, Ohio, is constantly subjected to temperatures between 350 and 450 degrees F. and occasionally to contact with molten resin which may surge out from a broken die. Under these severe operating conditions, Class A insulation was found to be short lived and it was decided to rewind the heater with fiberglas on a trial basis. While occasional rewinding is still necessary, fiberglas is proving to be the most efficient insulation yet discovered by the Peerless engineers and is rendering excellent service in the plastics industry. Shutdowns are less frequent, production schedules can be maintained at highest levels and maintenance supervision is at a minimum. It has also been found that the heater can be rewound more quickly when fiberglas is used, resulting in a further reduction of hours required for re-insulating.

Three layers of 0.015-inch varnished fiberglas cloth are applied on the core. Eleven layers of number 11 SGE wire with fiberglas tape insulation are used between the turns and ¾ by 0.01-inch fiberglas tape is applied as an outside wrapping. The tape is held tightly in place by sewing the ends or tying them down with fiberglas cord. The performance of this installation demonstrates the value of specifying high-temperature insulation for jobs where operating conditions are more than normally severe.

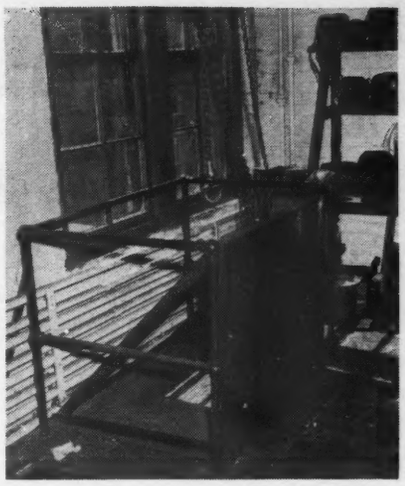


FIG. 1—When hoistway is not in use, one shield covers opening while other section serves as a vertical barrier.

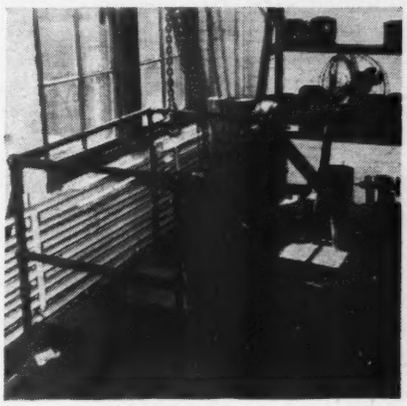


FIG. 2—When chain hoist is in use, shields are rotated 90 degrees, opening the shaftway while maintaining a vertical barrier.

Pivoting Shields Protect Shaftway

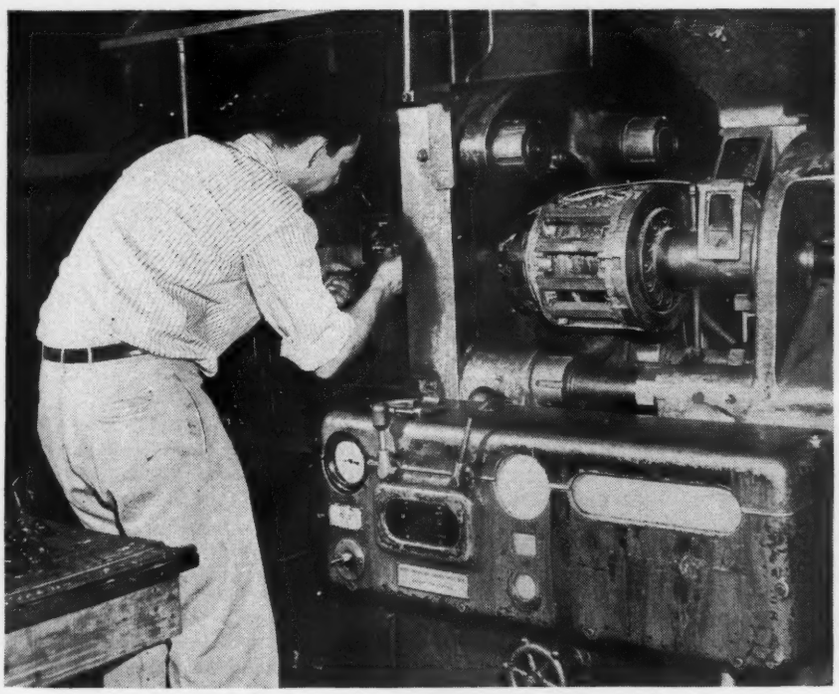
SAFETY

Twin sheet steel shields, rigidly mounted at right angles to each other, serve as double-purpose guards for a hoistway opening at the second floor level of the shop operated by the A-C Motor Service, Inc., Jersey City, N. J.

The shields, intersecting in a line along one lip of the hoistway frame, are pivoted about this intersection. When the hoistway is not in use, the assembly is tipped forward so that one shield horizontally covers the floor opening and the other shield serves as a vertical barrier. (Fig. 1). The shield over the opening acts as a fire-stop by sealing the shaft and eliminating the possibility of flue action. The vertical side prevents shop personnel from stacking equipment on top of the sealing section.

When it is desired to raise or lower motors or equipment through the floor opening, the shields are quickly rotated about their horizontal axis so that the formerly-vertical shield descends to lie flat on the floor while the other shield swings upward, maintaining the safety provisions of a vertical barrier. (Fig. 2). With the assembly in this position, the now-vertical section serves as a protective parapet across the front edge of the hoistway. The other sides of the opening are guarded by pipe railings.

The overhead chain hoist operates from a ceiling-mounted monorail that extends from a point over the shaftway to the rear of the second floor shop area. An end-stop and automatic latch on the monorail locks the chain block directly over the hoistway until manually released by an operator.



Operating under temperatures up to and beyond 450 degrees F., an induction heater employed by the Peerless Molded Plastics Company of Toledo, Ohio, gives satisfactory performance when insulated with fiberglas.

Sales Soar when MITCHELL Lights the Modern Store!

Model No. 3011
DELUXE LOUVERED
LUMINAIRE

BEFORE—
The George W. Peck Hardware Co. store, Elmira, N. Y., as it appeared before re-lighting. Inadequate, uneven illumination, only 2½ to 6 foot-candles by actual measurement.

AFTER—
Here's the same store "sales-activated" by 52 MITCHELL De Luxe Louvered Luminaries Model No. 3011. Uniform 35 foot-candles over the entire area! Another example of "selling" atmosphere created by MITCHELL Lighting.

The George W. Peck Hardware Company made sales soar when they replaced their obsolete lighting with a modern MITCHELL Fluorescent installation that changed the average foot-candle reading from only 4 to a full 35. The entire store is now a sales-inviting establishment—flooded uniformly with abundant, glareless light. *Now*, customers see what they want quickly. They *buy more* because they *see more* to buy. Merchandise looks more attractive—is easier to demonstrate and sell. Here is "sales-engineered" lighting—good for the customer, good for salespeople who work with less strain and fewer errors, good for bigger sales and profits. Yes, sales soar when MITCHELL lights the modern store!

Installations like these build tremendous user acceptance for MITCHELL Lighting—mean better business for the wholesaler. MITCHELL sales are package transactions—trouble-free volume business. MITCHELL installations are easy, smooth jobs for the contractor—time-saving, profitable business . . .

Mitchell Manufacturing Company
2525 CLYBOURN AVENUE, CHICAGO 14, ILLINOIS
In Canada: Mitchell Manufacturing Company, Ltd., Toronto, Canada
Far West: *Complete Modern Plant and Sales Office at Los Angeles Serves the Entire Pacific Coast Area*
1019 NORTH MADISON AVENUE, LOS ANGELES 27, CALIFORNIA

MITCHELL

Better Light for Better Business

Makers of Commercial and Industrial Fluorescent Lighting Equipment
Store Window Lighting • Spotlights and Floodlights • Desk Lamps • Portable Floor and Table Lamps • Bed Lamps • Ultraviolet and Infrared Health Lamps • Residential Lighting Specialties . . . Rad-i-Air Germicidal Units (made by Tru-Air Ultraviolet Products Co., Los Angeles)

Channel Feeder Follows Column Line

WIRING

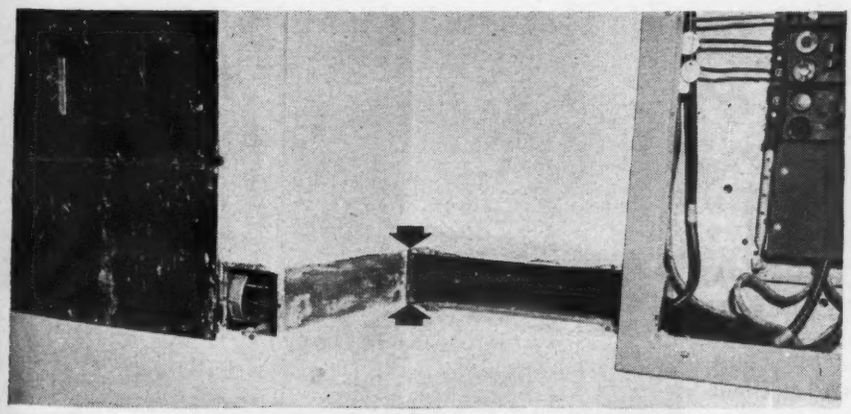
During an electrical installation project at the Dayton Company Store in Minneapolis, Kvalsten Electric Company, Minneapolis electrical contractors, installed numerous busduct risers comprising the main distribution system. One of these ducts passed through a general office area and was concealed in a plaster column enclosure. The face of the branch circuit tap-off unit was flush with the finished plaster.

Kvalsten encountered the problem of installing a concealed feeder from the duct tap-off unit to a 42-circuit lighting distribution panel mounted flush in the outer wall only a few feet from the duct column. Dimensional limitations and two sharp 90 degree offsets precluded the use of conduit.

George L. Gustafson, construction engineer for Kvalsten Electric Company, solved the problem by designing an L-shaped 4-in. by 4-in. square metal channel with removable face plates. The raceway was installed flush in the column and wall; one end being coupled to the side of the riser duct tap-off unit, the other to the side of the panel cabinet.

To prevent chafing and cutting of conductor insulation, a split fibre tube was snapped over the inner channel brace at the wall and column line. After the screw covers are mounted, the complete channel is painted to match the wall color.

Extra space at bottom of bus duct tap-off unit facilitates cable installation. Hinged cover permits quick clamp-on meter load test.



Square steel flush raceway between busduct riser tap-off unit (at left, circuit breakers not yet installed) and adjacent lighting distribution panel. Covers are removed to show feeder cables and split fibre tube (arrows) to protect conductor insulation.

Gunmount Principle for Industrial Trucks

INDUSTRIAL

Concentrated storage space permits the expansion of production space and has increased general plant efficiency at the General Controls Company, Glendale, California. The concentration of materials in smaller areas has become possible through the use of material-handling machines constructed on the principle of a swiveling warplane gunmount. The machines are capable of negotiating narrow aisles, tight corners, steep ramps and abrupt changes in grade.

In a study of the space problem, six points were stressed by John Holzman, chief of the inventory department for General Controls, as essential requirements for material-handling machines. These points included speed, adaptability to small working spaces, greater pulling power, economical operation, minimum requirements for operating manpower and additional equipment, and versatility. The unit selected by General Controls to achieve these requirements was the Turreteer, manufactured by Salsbury Motors, Pomona, California.

Turret principle is used on materials-handling machines used by General Controls, Glendale, California. Revolving turret and traction wheel permit maneuverability in close quarters. Parts can be concentrated in smaller stock areas, resulting in greater available space for machinery and manufacturing processes.

After six months of use, the company claims that the time-saving factor is 20 percent as compared with manually operated hydraulics. The machines are used for interdepartmental transportation of castings and other materials from inventory points to areas of use, for work in the salvage yard to haul equipment and oil barrels, and in the inventory areas to resupply stock piles. The units are powered by gasoline engines developing six hp. at 2650 rpm. Continuous operation of from 10 to 12 hours requires 3.5 gallons of gasoline. Loads of two tons can be moved on standard skids at speeds ranging up to 8 mph.

The machines have three controls; throttle, steering turret and brake. Automatic shifting selects transmission ratios best suited for moving the load being handled. A "dead man" brake prevents the continued operation of the unit in the absence of an operator at the controls. Widely-spaced wheels give balance and stability.

Ease of handling in cramped quarters is due to a turret-mounted power plant and direct drive of the traction wheels. Shifting and reversing mechanisms are unnecessary, the power unit and drive wheel rotating in the direction of travel, similar to the operation of a swiveling gunmount on a warplane. The principle was developed by Salsbury, a subsidiary of Northrop Aircraft.

Get the drop

DESIGNER & INSTALLER DATA:

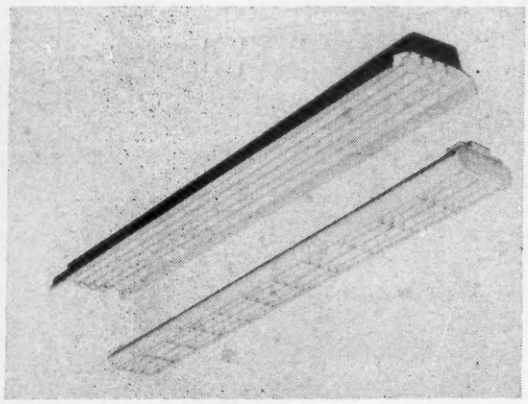
A ten-foot standard ventilated section of 1000A, 3 Phase 4 Pole Lo-X feeder duct. At 90% power factor, voltage drop per Ampere per foot is .0000255 Volts. Carrying rated load of 1000A, temperature rise will be 26°C above ambient.

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising department, tell them in what issue of ELECTRICAL CONSTRUCTION and MAINTENANCE you saw the item and they will send full details to you.

Equipment News

Slimline Units

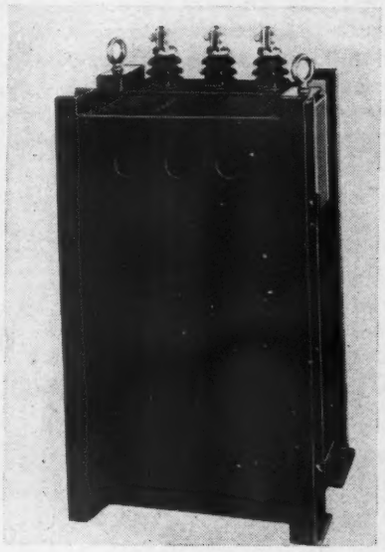
These new slimline units are known as the New Horizon series. They are for both commercial and industrial installations. Available also is a new slimline Trofferlite. Units accommodate four 96T8 slimline lamps and are equipped with two 2 lamp ballasts for 200-milliampere operation. Commercial fixtures are supplied for either surface mounting or stem suspension. They have a curved individual reflector over each lamp. Reflector is removable for direct-indirect lighting. Industrial units are 96½ in. long by 13 in. wide by 7 in. deep. Commercial fixtures are 97 21/32 in. long by 16 1/16 in. wide and 5 3/16 in. deep. Leader Electric Company, 6128 Broadway, Chicago 40, Ill.



LEADER SLIMLINE UNIT

Air-Cooled Distribution Transformers

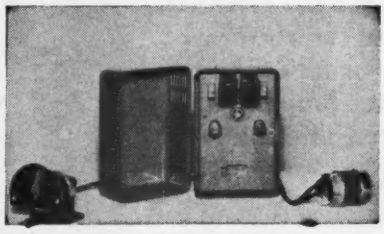
An improved line of dry type distribution transformers has been announced. Features include the use of Class B, heatproof insulation such as fibreglass, mica, asbestos and other inorganic materials; improved natural draft, more compact built-in low voltage wiring compartment, suitable for conduit wiring. The elimination of toxic liquids permits indoor installation at the load center without a fireproof vault. Designated as Type S, they are available in both single and three phase up to 100 kva., in voltages up to 4800. Marcus Transformer Co., Inc., 32 Montgomery Street, Hillside 5, N. J.



MARCUS TRANSFORMER

Electronic Control System

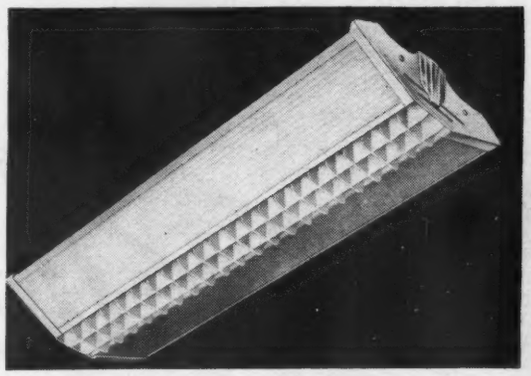
A new electronic positioning control system designed for such applications as controlling inaccessible dampers from control stations on the floor, positioning heavy work in machine tools, and opening, closing and adjusting to intermediate points valves and gates from a single coordinated control desk has been announced. The system has three parts—a master control station and follow-up device, which can be either small selsyns or potentiometers, and an electronic control panel. The master control station may be placed in any desired location, because it is connected to the control panel by three control leads. The system can be used on drives up to 1½ hp. in general. Control panel is enclosed in a NEMA Type I case and is hinged to swing out for servicing and inspection. General Electric Co., Schenectady, N. Y.



G-E CONTROL SYSTEM

Commercial Unit

A new commercial fluorescent lighting fixture, known as Vanguard, has been added to the Silv-A-King line. It is of a modified "V" design with egg-crate louvres. The side panels are of frosted fluted glass, and end sections are slotted. The units may be mounted in continuous rows without removing the ends or using special parts or fittings. It is recommended for installation in offices, stores, showrooms, hospitals and schools. Bright Light Reflector Co. Bridgeport, Conn.

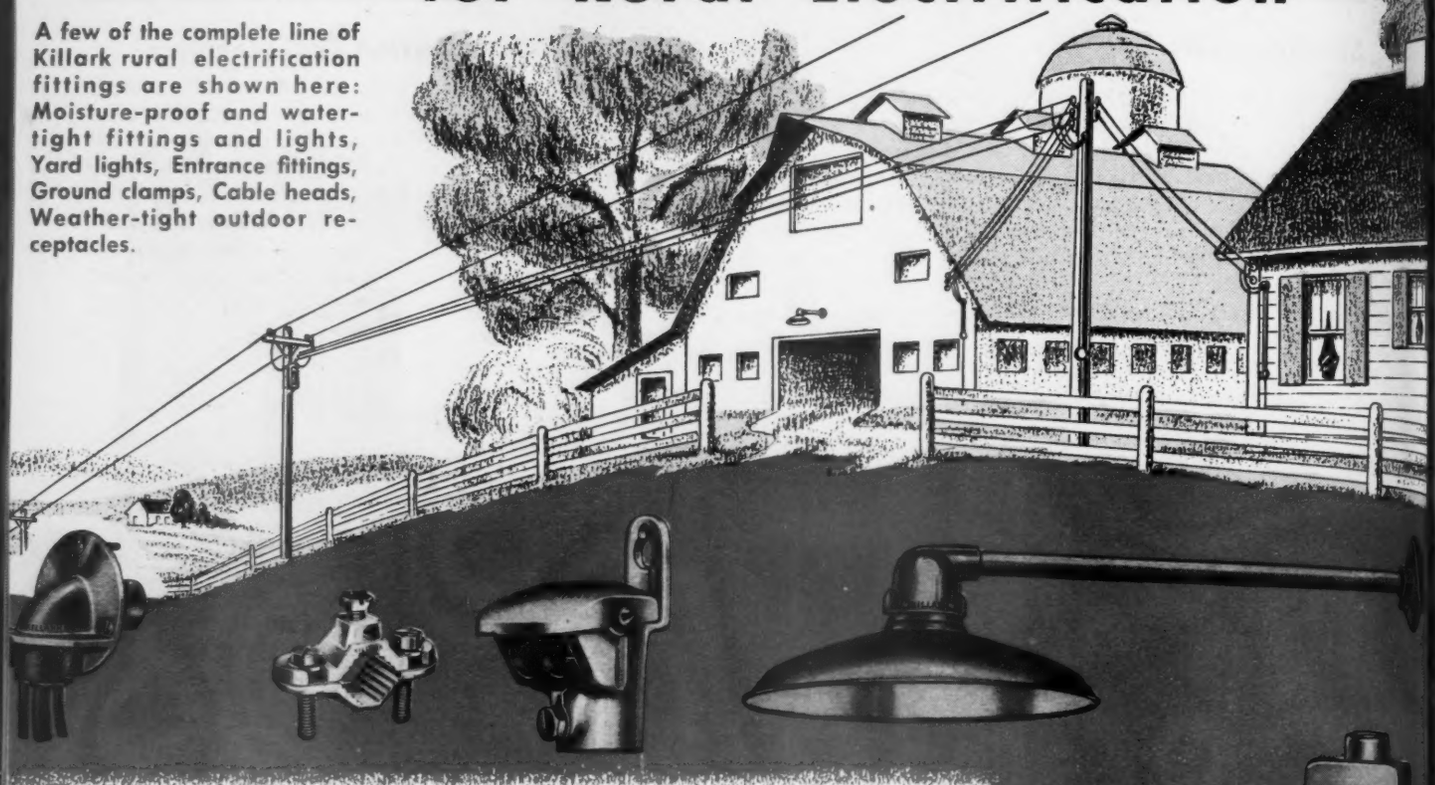


BRIGHT LIGHT VANGUARD

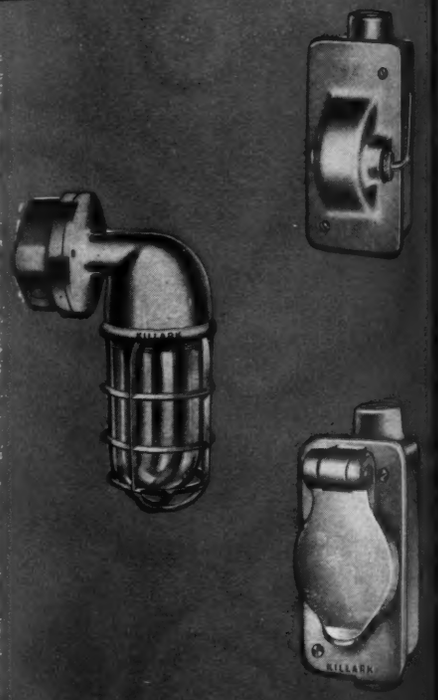
REAP YOUR HARVEST THIS SUMMER

With KILLARK Fittings for Rural Electrification

A few of the complete line of Killark rural electrification fittings are shown here: Moisture-proof and water-tight fittings and lights, Yard lights, Entrance fittings, Ground clamps, Cable heads, Weather-tight outdoor receptacles.



o take full advantage of the many new miles of REA lines, every farm eeds a host of electrical installations . . . outlets for cream separators— ilking machines—churns—saws—pumps—washers—refrigeration—lights house, barn, workshop, chicken house. Many new jobs for the electrical ntractor with a complete line of REA fittings. The electrical contractor who ncentrates on the KILLARK Line is especially qualified for REA jobs be- use he can be supplied with every fitting he needs, and the proper fittings from his Killark wholesaler. Write for Killark's illustrated informational lletin on Rural Electrification Fttings.



KILLARK ST. LOUIS

Killark

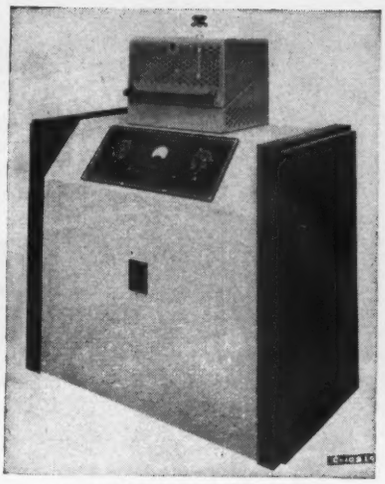
ELECTRIC MANUFACTURING COMPANY

Offices and Warehouses: Atlanta, Baltimore, Boston Chicago, Denver, Los Angeles, Pittsburgh, San Francisco, Seattle and Syracuse. Offices: Cincinnati, Cleveland, Dallas, Detroit, Kansas City, Minneapolis, New York, Philadelphia.

Vandeventer & Easton Ave.
SAINT LOUIS 13, MO.

Dielectric Heating Generator

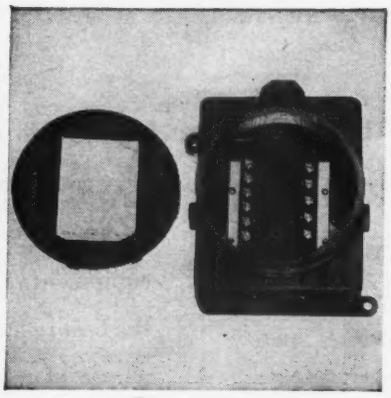
A new 2 kw. r.f. generator, the dual timer 40.9 Mc set, is now available. It features a special cubicle providing two sets of operating controls to permit alternate operations of the generator on two different time cycles. Thus it is possible with a single generator to supply heated plastic preforms alternately to two presses operating on different loads. Two adjustable automatic timing relays built into the control panel provide alternate power-on periods of from 0 to 165 seconds each. Separate start and stop pushbuttons and "load on" indicator lights are provided. The input current meter and filament indicator are in the control panel center. Employing two Type WL-872-A rectifier tubes and an industrial type air-cooled WL-473 oscillator tube, the generator is equipped with an air-maze cleanable filter for dust-free cooling air. Westinghouse Electric Corporation, Pittsburgh 30, Pa.



WESTINGHOUSE GENERATOR

Level Control

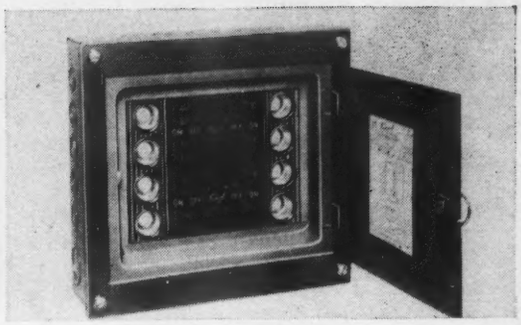
Level control, Type 10CB1X has been designed for general application with particular consideration to the problems of the chemical processing field. It is an a-c control that combines a probe circuit and transformer to operate a relay. It is supplied in an explosion-proof housing, or in a pressed steel, dust-tight enclosure. The explosion-proof housing is used on installations where it is desirable that the level control which carries the current required to operate the pump be explosion-proof, even though it is permissible to pass a minute electrical current at low voltage through the liquid itself. Rating is 115 or 230 volts, 25/60 cycles a-c. Output is 2 amperes at 115 volts; 1 ampere at 220 volts. Photoswitch Incorporated, 77 Broadway, Cambridge 42, Mass.



PHOTOSWITCH CONTROL

Panelboard

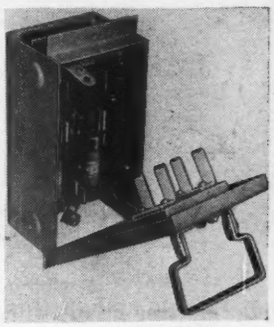
An improved Noark NTPS panelboard for the control of light and small power circuits has been announced. Available in 4 to 12 circuits, flush or surface type. Improvements include the incorporation of a steel tension spring in the switch assembly which exerts constant pressure on stationary contact parts to assure positive electrical contacts. The three current carrying parts in a circuit have also been made heavier. The panel's four-plug-fuse and toggle switch phenolic units have been re-designed. Another feature is the shallow depth of the steel enclosure, 3⅞ inches, which permits flush type panels to be mounted in thin walls of sheet rock, wall board, masonite and other materials. They are designed for installations in homes, offices, stores, factories, apartment buildings, and schools. Federal Electric Products Company, Newark, N. J.



FEDERAL PANELBOARD

Safety Switch

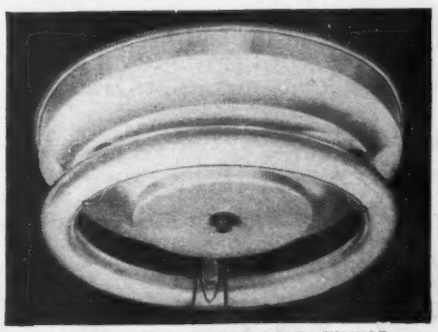
The new Rota-Swing switch for dead-front panels and switchboards, gives the operator positive protection, because the opening of the door to reach the fuses automatically opens the circuit. The exposed parts can carry no current. It has a rotating handle that moves the knife blades to off or on position. Switch is suitable for heavy duty power and light applications, and can be furnished for switchboards or panels of any size or capacity: 0 to 600 amps.; 250 volt d-c to 600 volt a-c; two, three or four pole. Each unit may be furnished with fuse gaps for any desired amperage or within a wide range. Changes in fuse gaps can be made at any time after installation. Pelham Electric Mfg. Corp., Erie, Pa.



PELHAM SWITCH

Fluorescent Fixture

A new "Circline" fluorescent overhead fixture has been announced, for kitchen, bath, basement, halls, workshop, etc. Known as the "Homecraft", it has a white enamel base, with clear Plexiglass lampholders. The lamp is 32 watt, 12 inches in diameter. It is for flush to ceiling mounting and has spring type knockout button for pull chain or dropcord. All electrical parts are GE-UL approved. Homecraft Electronic Products, 1208 South Kedzie Ave., Chicago 23, Ill.



HOMECRAFT FLUORESCENT FIXTURE

You'll know you're getting

THE BEST REFLECTOR SURFACE... ALZAK* REFLECTORS

You're getting an all-aluminum reflector shell, with the integral Alzak* finish that has lighting efficiency as high as 83%. A reflecting surface that will not chip or peel. That does not rust and spall if dented. That is readily restored to high efficiency by washing with soap and water. Light to lift and hang . . . puts less load on outlets and supports.

*Patented process.

These are the reasons why you should specify Alzak Reflectors, made in every commercial style and type by leading manufacturers of lighting equipment. You are sure of getting the best reflector available. For the names of manufacturers of Alzak Reflectors, write to ALUMINUM COMPANY OF AMERICA, 1946 Gulf Building, Pittsburgh 19, Penna. Sales offices in leading cities.

FOR CUSTOM-MADE, SPECIAL JOBS

you can get high-efficiency Alcoa Lighting Sheet from your nearby Alcoa Distributor. This sheet is readily formed and bent to make lighting troughs, corner reflectors, and other special reflectors not available as stock items.

MORE people want MORE aluminum for MORE uses than ever

ALCOA FIRST IN ALUMINUM

ALCOA ALUMINUM

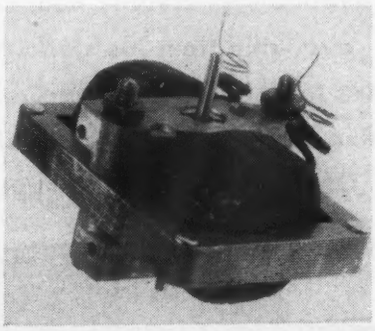
IN EVERY COMMERCIAL FORM

Hinged Connector

O. Z. CONNECTOR

A new XTP line of hinged connectors has been announced. Available in 25 sizes, accommodating over 400 wire combinations ranging from No. 8 to 1,000,000 CM, the XTP will do practically all tap jobs. They are of the one piece, hinged construction type. Can be permanently attached to the main and left for the tap to be attached later. One end of the connector is snapped over the main and tightened, the other has serrated openings to which a tap can be run in any of three directions. O. Z. Electrical Manufacturing Co., 262 Bond Street, Brooklyn, N. Y.

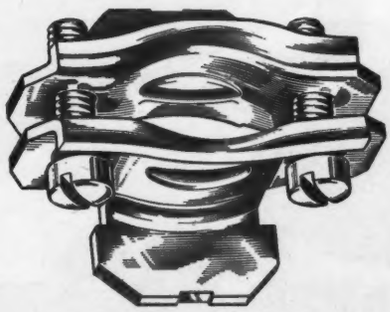
Induction Motor



GLEASON-AVERY MOTOR

A new four pole single phase shaded pole induction motor (B-30-A) has been developed. It operates on a-c. Because the input power is substantially constant from no load to blocked rotor conditions, when operating under constant voltage, the motor may be used in operations where the load is driven against a stop. It can then remain energized in this stalled position without being overheated. For a duty cycle which might consist of approximately ten minutes operation out of every hour, the motor coils can be adjusted to give a relatively high torque and large power input, according to the manufacturer. Where the duty cycle demands that the motor be continuously energized, the winding is designed so that the total temperature does not exceed approximately 90° C. Gleason-Avery, Inc., Auburn, N. Y.

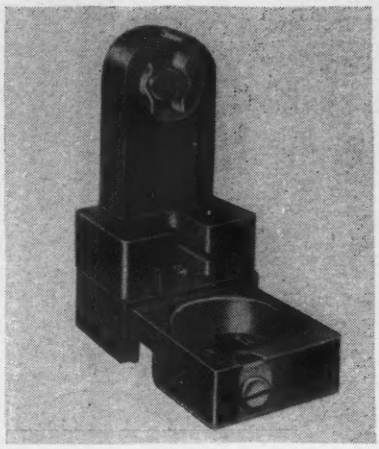
Cable Connector



TOMIC CABLE CONNECTOR

A new non-metallic cable connector for commercial and residential wiring has been announced. These connectors fit in quickly and easily from the outside on all standard K.O. boxes, and the cable is slipped through and kept in position with two tightening screws and locking feature. It may be used on both old and new type sheathed cable, and is available in ¾ in. and a ½ in. size which carries the Underwriter's approval. Tomic Sales and Engineering Company, Detroit, Mich.

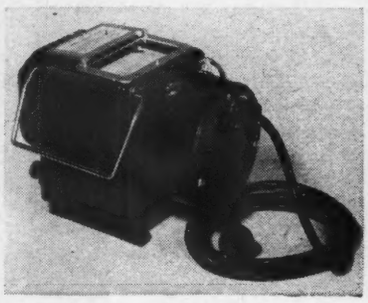
Lampholder



SOLAR LAMPHOLDER

A new line of fluorescent lampholders and lampholder-starter sockets for use in original equipment and replacement has been announced. They are made of chip-proof, shock-proof bakelite with high dielectric strength. They are of one-piece construction. Insertion and renewal of lamp and starter are simple and permit one hand servicing. Slots in lampholders guide lamp ends into position, a twist of lamp locks it into holder. They fit all standard fluorescent strips, troffers, luminaires and other types of equipment. Solar Electric Corporation, Warren, Pa.

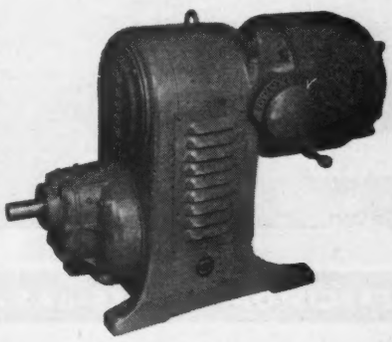
Insulation Tester



BIDDLE MEGGER

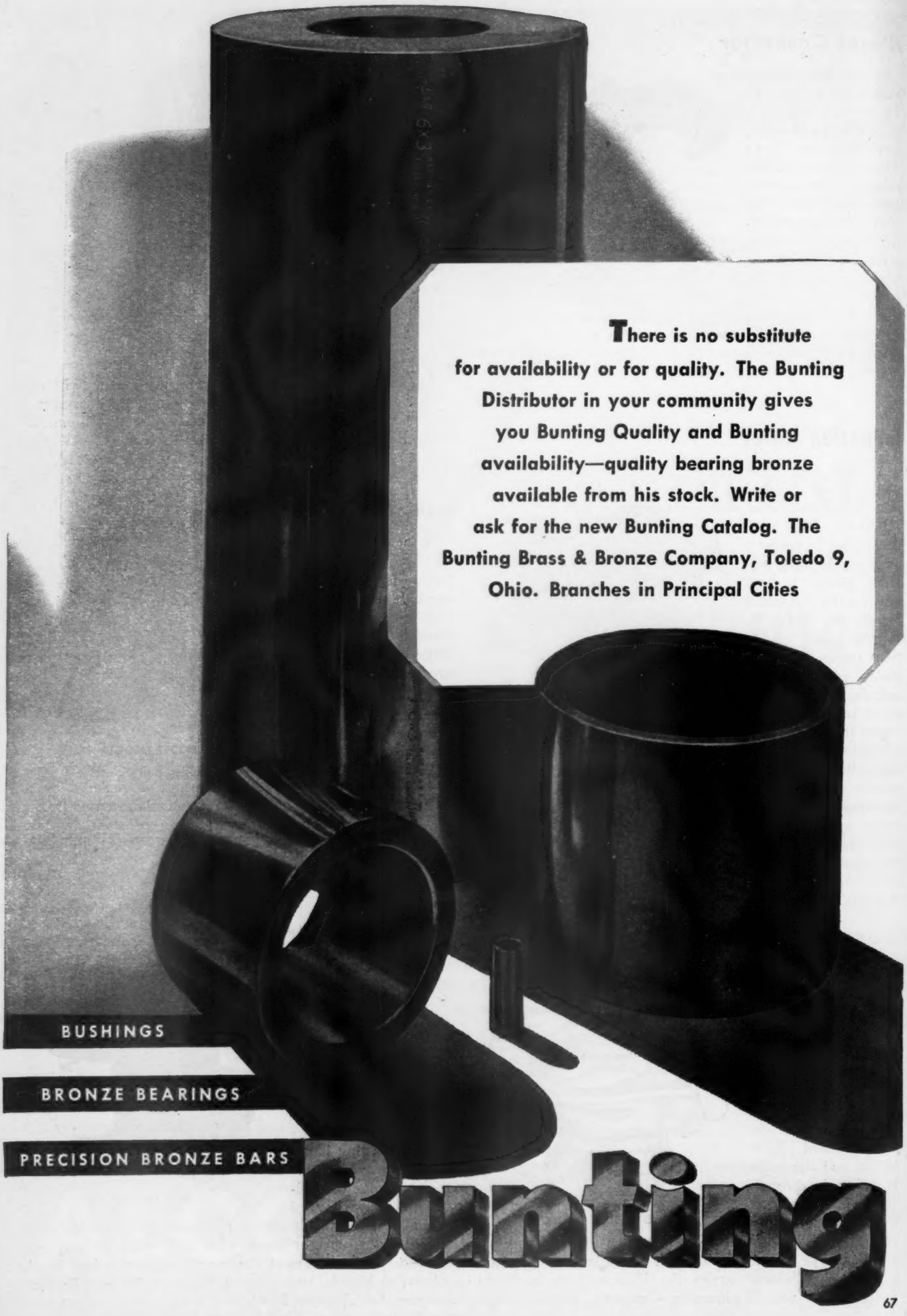
A new plug-in type of "Megger" insulation tester has been developed. It operates on 115 volts a-c. It is recommended for use where a large number of tests are to be made at one time and also where an individual test is continued for many minutes. The rectifier-operated "Megger" is a modification of the "Meg" type insulation tester. The hand generator is replaced by a power pack consisting of a constant-potential, step-up transformer and selenium rectifier giving a constant d-c test voltage. James G. Biddle Co., 1211 Arch Street, Philadelphia 7, Pa.

Varidrive Motor



U. S. MOTOR

First of a new series of variable speed drives, designated as size 23, has been announced. Among the features claimed are smaller size for a given hp.; longer belt life; more convenient positioning of the speed adjusting handwheel; provision for easier change of varibelts. A variety of assemblies is available such as: horizontal frame with shaft left or right, upright frame with shaft high or low, and built-in speed reducers of single or double reduction. U. S. Electrical Motors, Inc., Milford, Conn. or 200 East Slauson Avenue, Los Angeles 54, Calif.


There is no substitute for availability or for quality. The Bunting Distributor in your community gives you Bunting Quality and Bunting availability—quality bearing bronze available from his stock. Write or ask for the new Bunting Catalog. The Bunting Brass & Bronze Company, Toledo 9, Ohio. Branches in Principal Cities
BUSHINGS
BRONZE BEARINGS
PRECISION BRONZE BARS
Bunting
67

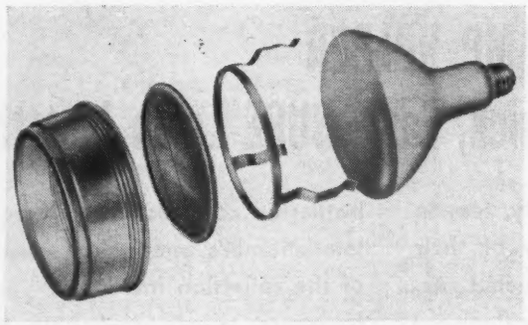
Fluorescent Instant Starters

The addition of fluorescent instant starters to this line of lamps, has been announced. Known as "P-D-Q", they are designed for more efficient fluorescent lamp performance it is claimed and are pre-tested and checked in actual service to assure lamp starting. Starters are ready to install and fit all standard fluorescent socket holders. They carry the Underwriters Laboratories approval. Solar Electric Corporation, Warren, Pa.

SOLAR STARTER

Spotlight Color Clips

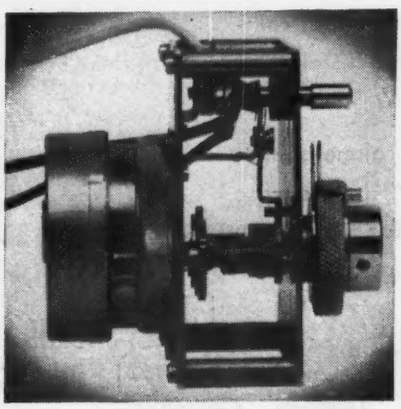
An aluminum color clip for the R40 reflector type lamps has been added to this line of display lighting sources. It is a two-part aluminum lighting accessory which consists of a holding ring with tension clips, plus a color filter. Both fit into a shielding holder casing. The unit clamps over the end of any R40 reflector bulb, either spot or flood type. Sixteen color filters, ranging from one-tone primary colors to two-tone hues of the red-pink and blue-green, covering all the usual display needs, are available. Sylvania Electric Products Inc., 500 Fifth Avenue, New York, N. Y.



SYLVANIA COLOR CLIP

Industrial Reset Timer

This new industrial reset timer for control of electrical circuits starts at the touch of a button and when the time cycle is complete, it resets automatically. The unit is designed to be permanently installed on a panel, and comes in time cycle ranges of 15, 30 and 60 seconds, 5, 15 and 30 minutes. The timer consists of two mounting plates, a reset synchronous motor, open type jack switch, reset button, cam, latch, torsion spring to return motor to original position, indicator actuated by motor, and adjusable stop held in position by a friction clutch. It operates on 110 volts, 60 cycles a-c, with a 1,500 watt capacity. American Time Corporation, Springfield 1, Mass.



AMERICAN TIMER

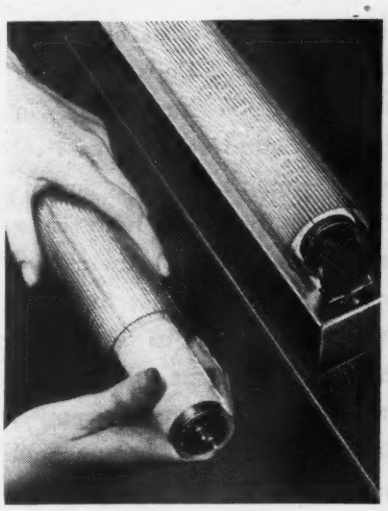
Pole Hole Digger

A new pole hole for power line work, has been announced. These machines are larger and heavier than the farm models. They can be mounted on a truck, tractor or jeep and will operate from the driver's seat. A feature is the mechanism for either raising or lowering the digger assembly for digging holes on a high bank or in a ditch. Auger diameters vary from 4 in. to 14 in. with depth adjustable from 44 to 72 inches. Continental Farm Machine Co., 1335 Metropolitan Life Bldg., Minneapolis 1, Minn.

CONTINENTAL DIGGER

Tulox Fluorescent Diffuser

Tenite tubing is extruded in transparent colors for diffusing fluorescent lighting in commercial and general installations of restaurants, hotels, stores, beauty salons, and homes. Diffusers are installed by slipping them over standard fluorescent lamps. The inner wall of the tube consists of longitudinal prisms, which diffuse the light, and spacer splines, which support the tube on the lamp. The outer wall is smooth. Inherent properties of Tenite plus the design of the diffusing prisms combine to reduce glare. Seven stock colors are made—yellow, orange, rose, red, green, blue, and clear. All diameters and lengths of Tenite diffusers are available to fit standard T-5, T-6, T-8, and T-12 fluorescent lamps. Tennessee Eastman Corporation, Kingsport, Tenn.



TENNESSEE EASTMAN DIFFUSER

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an advancement in Quick, Easy, SURE Lamp Insertion

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2217-RS

Understanding Magnetics

R. N. Eck
Supervising Engineer
Cutler Hammer Inc.

THE TERM "magnetics" can aptly be used to denote the study of magnetic lines of force, or flux. This article will deal basically with the production of magnetic flux and with some of the principle effects. It will be concerned primarily with electro-magnetism, or magnetic flux produced by electric currents rather than that produced by permanent magnets.

Magnetic Flux

The most fundamental concept of "magnetics" is that magnetic lines of force exist around a conductor carrying a current. If the current is steady the flux is steady, and if the current alternates the flux will also alternate. The amount of flux varies with the magnitude of the current. If we coil the wire to form a closed loop, all of the flux passes through the loop and returns around the outside of the loop. Such a coil of wire, with an electric current in it, comprises the magnetizing force or seat of excitation which produces the flux in all electro-magnetic devices. The value of the magnetizing force is proportional to the number of turns in the coil and to the current.

Magnetic flux, similar to water or an electric current, will take the path of least resistance. Magnetic resistance is termed reluctance. A given magnetizing force will produce an amount of flux depending inversely upon the reluctance of the magnetic circuit. Air or non-magnetic materials offer a relatively high reluctance to magnetic flux whereas iron or ferromagnetic materials offer a very low reluctance. Stated in other terms, the latter are much more permeable. The ratio of reluctance between air and good transformer iron is often as high as 6,000 to 1. In this case, a given magnetizing force can produce 6,000 times as much flux in iron as in air, the iron path being of the same average cross section and length as the air path.

There are several other important distinctions between iron and air in their magnetic behavior. Magnetic flux in air is directly proportional to the ampere-turns of excitation. This is true in iron only up to a certain point. Beyond this point the reluctance gradually increases, and additional ampere-turns excitation produce decreasing increments in flux. The iron becomes saturated, and the production of a relatively small increase in flux under this condition might require a very great increase of current in the magnetizing coil.

Finally, under complete saturation, increased magnetizing force produces no greater increase of flux in the iron than it would if the iron were replaced by a void air space. Note that it is the incremental flux which is referred to and not the total flux. The curves in Figure 1 illustrate this effect which is displayed by all magnetic materials, although at widely different values of flux density.

Saturation is generally undesirable,

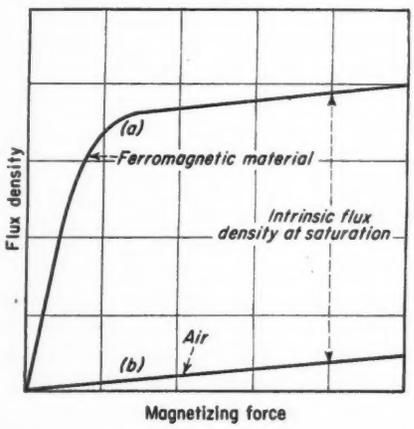

FIG. 1—Flux density in a magnetic circuit (a) with ferromagnetic material and (b) with air.

and only in special cases is iron intentionally operated with sufficient flux to produce this condition to a greater or lesser degree. Some ferromagnetic circuits are built with an air gap for the purpose of reducing the flux, thus giving a linear relationship between flux and ampere-turns over a wider range of excitation.

All magnetic materials will retain a certain amount of magnetism after the magnetizing force is removed. Certain so-called hard materials are particularly strong in this characteristic and are, therefore, well suited for permanent magnets. Such materials are also difficult to magnetize. However, in most electro-magnetic applications, this characteristic, if too strong, is definitely undesirable. It is quite evident that in relays, generators, and similar devices, we would like to have the flux density become very nearly zero when the magnetizing force is removed. This condition can be met satisfactorily by the selection of the proper material.

Iron also introduces losses into the magnetic circuit which appear in the form of heat. These core losses are due to two effects. The iron has a tendency to keep its magnetism and to resist any change in it. The resulting loss might be thought of as due to friction within the atoms and is commonly labeled hysteresis loss. The other is an I^2R loss due to the induced circulating currents in the iron, and is called eddy-current loss. On a-c the hysteresis loss is proportional to the frequency and to the maximum flux raised to a power of about 1.5 to 2.5 depending upon the iron. The eddy-current loss is proportional to the square of the frequency and the square of the maximum flux. It should be noted that neither of these losses will occur unless there is a change of flux in the iron. Thus there would be no iron loss in a magnetic circuit excited by d-c. A loss would occur only at the time of flux buildup or decay.

Special types of iron are available for magnetic use which have an exceptionally low hysteresis loss. These irons, usually sold as electrical sheet steel in gauges from 22 to 29, contain silicon in varying degrees up to about 4 percent. Increasing the silicon content reduces the hysteresis losses, but the cost of fabrication rises because the sheet becomes harder and thus more difficult to shear. The lower silicon steel has a higher saturation point which makes its use desirable on applications where core losses are not too important a factor. The higher silicon steel has a lower residual magnetism and is preferred in some magnets to overcome the tendency to stick closed.

To decrease the eddy-current loss it is necessary to break up the induced circulating currents. This is done by building the magnetic structure of thin, insulated laminations. An efficient a-c magnet must be laminated. Since eddy-currents oppose a change in flux, some d-c magnets are laminated to reduce this effect and make the magnetic action faster. However, d-c magnets generally are not built of laminations, but are cast or machined in the shape desired.

It is obvious that iron is of great importance in magnetic circuits. First of all, it is an amplifier of magnet flux. It causes much more flux to exist in a given space than could reasonably be produced in air alone. We shall see that this is very important, since many devices depend for their operation upon a large, concentrated magnetic flux.

Iron also serves to direct the flux because it provides a much lower reluctance path than air. In circuits containing large air gaps the flux tends to spread out or fringe, and the stray flux or leakage may become as great or greater than the useful flux. Iron in the circuit holds such leakage to a minimum and thus harnesses the flux by concentrating it where it is required.

In studying the behavior of magnetic flux, three fundamental, and not altogether unrelated, effects will be investigated. These are: induction, magnetic pull, and force on a conductor.

Induction

Induction refers to that property wherein a changing magnetic flux induces an electric voltage in a wire or coil which is linked by this flux. Further, the induced voltage is in such a direction as to tend to oppose the change in flux. If the flux linkage is large or if the flux changes rapidly, this induced voltage might be very high. The change in flux linkage which causes the induced voltage can be produced in several ways. The flux might alternate due to an a-c exciting current as in a transformer, the field or coil might be given an angular velocity as in a motor or generator, or the change might be caused by opening or closing the circuit to a d-c exciting coil. Induction opposes the flux change by opposing the change in current which is responsible for the flux change, and also by causing an opposing magnetomotive force in any other closed coils on the same magnetic circuit.

Let us first consider that a d-c voltage is applied to a coil. Any wire or coil is, of course, inherently inductive. If the coil consists of a large number of turns on an iron magnetic circuit it will be highly inductive and therefore the effects described will occur to a greater degree. A current will at once start to flow in the coil and, by reason of the ampere-turns excitation on the magnetic circuit, a flux will start to build up. This increasing flux induces a voltage in the coil which opposes the current building up. It cannot actually prevent this increase in current, but merely retards it, and the current will finally reach a steady state value determined only by the coil resistance and the impressed voltage. A steady magnetic field now exists which contains a definite amount of energy transferred from the electrical circuit.

When the impressed voltage is removed from the coil, the current decays and the magnetic field starts to collapse. However, an induced voltage immediately appears and opposes this change. The value of the voltage depends upon how fast the electrical circuit is opened, since the energy in the magnetic field is dissipated in the arc at the point where the circuit is broken. The faster the circuit is broken, the greater the voltage required to maintain the arc. A certain amount of energy will be dissipated in coil copper loss but this is, of course, contingent upon the current being continued through the arc. A common means of reducing the arc on highly inductive circuits is to place a resistor across the coil and thus provide a path for the magnetizing current after the main circuit is broken. In this case all of the magnetic energy is dissipated in the coil and resistor, assuming that no arc occurs, and the instantaneous induced voltage which builds up across the coil will be equal to the current in the coil at the time of circuit interruption multiplied by the value of the resistor. This voltage decays to zero as the field collapses.

On alternating current the inductive behavior is continuous, since there is a continuous change in the impressed voltage and, therefore, in the magnetizing current. With the magnetic field alternately building up and then decaying, it is at one time taking energy from the electrical circuit and, at another, giving up energy. Except for losses due to coil and iron heating, the total energy taken from the power source would be zero.

If we assume no losses, the relationship between coil current (I) and impressed voltage (V) is as shown in Figure 2. The coil current is shown passing through zero at a later time than the voltage because the induced voltage, in opposing the impressed voltage, causes the current to lag. It tends to prevent the current from build-up as the impressed voltage rises and also to hold the current up as the impressed voltage falls. The amount of lag is shown to equal $\frac{1}{4}$ cycle because, as can be seen by the power curve (P), only at that point will the energy consumed be equal to the energy given up. The power is, of course, the product of the instantaneous values of the current and the impressed voltage. If we now take losses into account, the current will lag by less than $\frac{1}{4}$ cycle for it can be seen that the positive power will then become greater than the negative power.

The induced voltage (E) is shown in Figure 2 in its relative position, being $\frac{1}{2}$ cycle out of phase with the impressed voltage. The net voltage, which supplies the magnetizing current and the losses, is the difference between V and E. It should be noted that there is a definite condition of balance here. A greater impressed voltage causes more magnetizing current to flow, which in turn produces more flux and a greater induced voltage. The current increases only enough to produce the flux, and induced voltage, required to again obtain balance. This depends to a great extent upon the magnetization curve of the magnetic material; in other words, upon how much current is required to increase

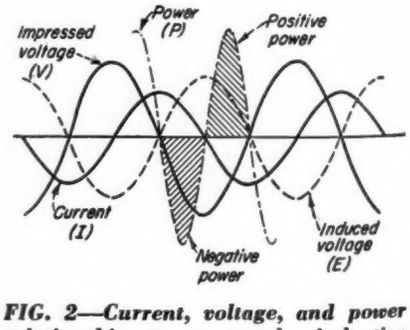

FIG. 2—Current, voltage, and power relationship on a purely inductive circuit.

the flux and to bring the induced voltage up to balance the increase in the impressed voltage.

It is obvious that coil resistance has a minor effect in limiting the a-c current when the circuit is highly inductive. It will limit only the initial inrush which takes place before the magnetic flux can build up. After that the induced voltage plays the major role in limiting the current taken by the magnetizing coil. This is true of all a-c magnetic devices.

Although induction is an important consideration in all magnetic apparatus such as generators, motors, relays, etc., the transformer has been selected here for the purpose of bringing out more thoughts on this subject. There are many types of transformers, differing in size and application, but an analysis of the current transformer and the potential transformer will cover the underlying principles of all.

Figure 3 shows a current transformer used in connection with an ammeter. Its purpose is to transform the heavy current in the a-c line to a low current so that a standard ammeter can be used to measure it. If we assume that 250 amperes flow in the single turn primary, we have 250 ampere-turns furnished by this coil. However, the secondary winding of, let us say, 50 turns has a voltage induced in it which causes a current to flow in the closed secondary circuit.

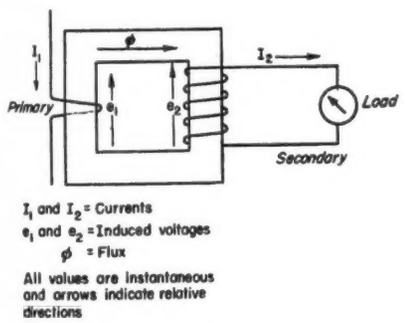

FIG. 3—Schematic diagram of a current transformer.

The resulting ampere-turns in the secondary winding oppose those in the primary, leaving only enough unbalanced ampere-turns to supply excitation for the iron. Normally this excitation requirement is made very small by proper design, and the ampere-turns in the secondary are considered equal to those of the primary. This transformer thus has a current ratio which is the inverse of the turn ratio. The secondary current will be 5 amperes.

It is interesting to consider the effect of an open secondary circuit on a current transformer. The primary ampere-turns are, in this case, not opposed by any ampere-turns in the secondary. Therefore the full primary ampere-turns supply magnetizing force on the iron. This is far in excess of the normal magnetizing force, so the flux reaches a very high value, limited by saturation of the iron. There will be two resulting effects. The iron will become hot due to large losses caused by the high flux density. Also, a high voltage will be induced in the open secondary winding and this might possibly cause breakdown between the turns or terminals. For these reasons, the secondary of a current transformer should never be opened when the primary is excited.

It is evident that the flux in the core of a current transformer depends upon the primary current, the frequency, and the secondary load resistance or burden. The secondary induced voltage must always be sufficient to cause the secondary current to be in the proper ratio to the primary current. If the secondary current were not high enough to counter-balance the primary ampere-turns, more flux would be produced to raise the secondary voltage. Of course, if the burden is too great, the iron will become saturated to such an extent that the excessive magnetizing current will seriously affect the ratio of primary current to secondary current, and the rated accuracy of the transformer will not be maintained.

A potential transformer, like a current transformer, consists of two windings on an iron core. However, there is little further resemblance in design and application. In this case we are concerned with transforming voltage rather than current, thus a given voltage is applied to the primary winding and another voltage is taken off the secondary. Figure 4 shows such a transformer schematically.

If we neglect the effect of impedance drop in the primary, the flux in the core of a potential transformer depends only upon the impressed primary voltage, the frequency, and number of turns in the primary winding. This is

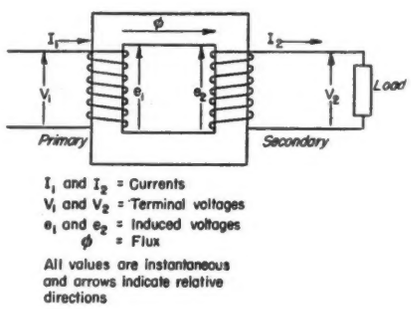

FIG. 4—Schematic diagram of a potential transformer.

because the voltage induced in the primary winding must be equal to the impressed voltage. With a given frequency and number of primary turns, there is a definite flux required to meet any condition of primary voltage. Were the flux not great enough, greater magnetizing current would be caused to flow because of the unbalance existing between the impressed voltage and the induced voltage.

Therefore, in a potential transformer with a fixed primary voltage, we have a magnetic circuit with essentially constant flux. A secondary winding will have induced in it a voltage which depends upon the number of turns in that winding. Now let us assume that a load is connected to the secondary of the transformer. The load current which flows in the secondary will oppose the magnetizing effort of the primary winding and will momentarily reduce the flux. However, a reduction of flux will decrease the induced voltage in the primary, and at once more primary current will flow to restore the flux. Thus the secondary load current is reflected in primary current as the inverse ratio of the number of turns in these windings.

It was previously stated that we were neglecting the effect of the impedance drop in the potential transformer. We will now briefly analyze this. The copper and iron losses and the magnetizing of the iron cause the transformer itself to have a certain resistance and reactance. This can be thought of as a lumped impedance in series with the load, and the voltage drop in this impedance, due to load current, subtracts vectorially from the voltage available at the load. This introduces the term *regulation* which is a measure of transformer efficiency. In any well designed transformer there will not be more than a 5 percent drop in secondary voltage between no load and full load. This corresponds to a regulation of 95 percent.

If the impedance of the load has the same ratio of resistance to reactance as the transformer itself, then the voltage drop will subtract directly and the effect on the regulation will be a maximum. However, if the power factors of the load and transformer are quite different, the vectoral subtraction makes the transformer drop less effective in reducing the secondary voltage.

Frequently a potential transformer is applied as a low voltage control transformer and must supply the heavy inrush currents of solenoids or contactors. If the voltage drop on the secondary is too great under this inrush condition, the solenoid or contactor might not close. In that case a

larger transformer would be required. However, if the power factor of the inrush current happens to be favorable, the regulation of the transformer will be greatly improved.

Magnetic Pull

Magnetic pull is something we all recognize as the motivating power of a solenoid, or of an armature on a relay or contactor. It comes about by reason of the fact that magnetic flux tends to cause a magnetic circuit to have minimum reluctance. Generally such magnetic circuits are designed with an air gap which can be closed, as in the case of a hinged armature type magnet, or with a gap in which the air is replaced with iron, as in a solenoid.

The force on a magnet armature or solenoid plunger can be shown to be proportional to $Fa^2 \frac{d\ Pa}{ds}$ where F_a is ampere-turns excitation across the air gap and $\frac{d\ Pa}{ds}$ is the rate of change of the air gap permeance as the magnet closes. Where there is no other air gap in the magnetic circuit, F_a can be considered to be the total ampere-turns supplied by the exciting coil. Air gap permeance is the reciprocal of reluctance and, in the case of parallel plane surfaces, is proportional to $\frac{A}{L}$ where A is the cross-sectional area and L is the length of the air gap.

It is not intended to get into mathematics here more than enough to show the proportionalities that exist. First, it can be seen that, if a flux is to produce a force, the permeance of its path must change with motion. The force is then directly proportional to the rate of change of permeance with motion at any given position of the magnet. It is also proportional to the square of the ampere-turns excitation across the air gap under consideration. This is less than the total excitation by the amount of ampere-turns required to force the flux through the iron and through any other air gaps in the magnetic circuit.

There are many shapes and sizes of tractive magnets. They differ in pull characteristics and are designed to meet specific applications. Requirements vary from the operation of a small relay to the lifting of many tons of scrap iron. A few common types are shown in Figure 5.

Figure 5a illustrates an efficient magnet known as the double "E" type. Forces are developed at all three air gaps and the motion of the armature is linear. The formula for the force developed between parallel faces, neglecting leakage, is as follows:

$$\text{Force, in pounds} = \frac{B^2 S}{72}$$

Where B flux density in kilomaxwells per square inch
S the area of the air gap in square inches

Assuming equal air gap area at all three points, the flux in the center leg divides equally between the outer legs and the flux density in the center leg is, therefore, twice that on each outside leg. Under this condition, the force on the center leg would be four times the force on either of the outside legs. Reduction of the air gap area on the outside legs would raise the force on these legs relative to the center leg. It would, however, reduce the total force since it increases the reluctance and lowers the total flux.

Figure 5b shows a similar magnet with only two air gaps and with angular motion. Again neglecting leakage, the flux in both gaps is the same, and, with equal air gap areas, the force developed at each gap would be the same. Of course, the torque developed at the upper gap is greater due to the greater moment arm.

Figures 5a and 5b, referred to above, are typical a-c tractive magnets. Figure 5c shows a d-c design. In this case there is only one air gap and it is of shorter length in order that sufficient flux can be developed by the higher resistance d-c exciting coil. A lock-out magnet is also incorporated in this figure. Once the flux has been established in this lower magnetic circuit, the upper circuit will not be able to close. By energizing the upper coil, and then allowing the flux in the lower circuit to decay at a definite rate, this type of magnet will give timed operation.

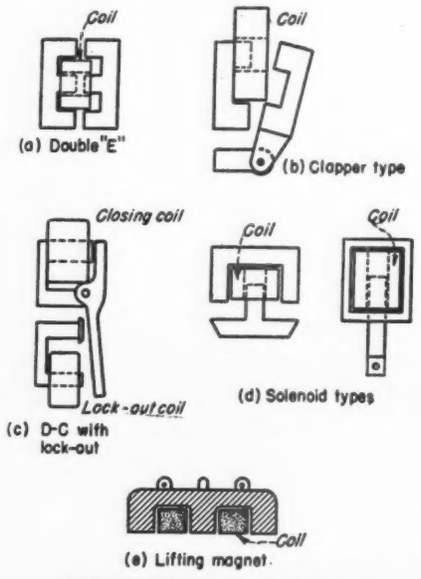

FIG. 5—Tractive magnets.

Figure 5d shows the typical solenoid type of magnet based upon linear travel of a plunger. In this type of magnet the air gap is not quite as clearly defined as in the parallel face type and the formula for force developed is much more involved. It will suffice here to say that by proper control of the saturation in the plunger as it travels in, and possibly by the use of special plunger shapes or magnetic shunts, almost any desired pull characteristic can be obtained on a solenoid type magnet. The force can be maintained fairly constant throughout travel or it can be made to increase or to drop off. This type of magnet is therefore well suited to many special applications and is also offered as a "packaged" power unit for general use. In order to obtain sufficient pull with a reasonably long stroke on d-c, it is generally necessary to put extra wattage on the coil during closing and reduce this to a lower holding value by use of an auxiliary switch, or other means, after the magnet has closed.

Figure 5e shows a lifting magnet. This magnet is excited by one or more d-c coils and exerts a great attractive force on magnetic materials. The high magnetism will result in considerable residual magnetism in the load after excitation is removed and it is therefore necessary to provide for reversing the excitation in order to drop the load. Other applications of magnetic power include magnetized pulleys, used for separating ferrous and non-ferrous materials, and magnetic clutches, which provide a convenient means of control on many drives.

It can be stated rather generally that the force on a tractive magnet varies with the square of the flux density and with the cross-sectional area at the point where the force is developed. Due to saturation there is a definite limit to the flux density which can be obtained. The more permeable iron will, of course, produce the greater force. Beyond this, more force calls for a larger magnet with greater magnetizing power in the coil.

The force requirement in any given application is well known, it being that necessary to overcome the effect of gravity, and whatever spring pressures there are which oppose the closing of the magnet. The force developed by most magnets will build up as the magnet closes due to the air gap shortening and the flux building up. This force must build up faster than the load against which it works if the

magnet is to follow through after it has started to close.

On a-c we have not only the decrease in air gap permeance to consider, but also a decrease in magnetizing force since the impedance of the coil increases as the flux builds up. This latter effect counteracts, to some extent, the flux build-up which would be caused by the former. Thus an a-c magnet develops a strong initial closing force. After the magnet has closed, the coil current is only a small fraction of its initial value. This makes the a-c magnet inherently self-protecting insofar as coil heating is concerned.

Since the d-c magnet does not have the advantage of a self-protecting coil, these coils frequently have only a part time duty rating, unless some external protecting means is provided. A d-c magnet with a continuous duty coil can, of course, be designed, but this is usually at the expense of shorter travel or a larger coil than a comparable a-c magnet.

There are usually two difficulties to be overcome in the design of an a-c magnet which are not present on d-c. One is its tendency to hum. Twice in every cycle the flux, and therefore the force, will pass through zero and this will cause a vibration if not corrected. The standard means for eliminating hum is to provide a shading coil. This coil is placed in the face on the magnet, and consists of a closed conducting path around only a portion of the iron. The induced current in this coil causes a component of flux which is out of phase with the main flux, and in this way prevents a null point in the combined flux at the gap. In addition to this, it is necessary to provide a good seal at the magnet face in order to eliminate all noise.

The other possible difficulty in connection with an a-c magnet is its tendency to slam. Since the initial closing force is, as we have seen, many times the final force required to keep the magnet closed, there is a high initial acceleration. On applications where high speed operation is important this high closing force is a definite advantage. However, on larger magnets where there is apt to be an undesirable slam on closing, a dashpot or cushioning spring is used to reduce the shock.

On a d-c magnet, the coil will have a much higher resistance and reactance than on a comparable a-c magnet. As this magnet closes, and the flux tends to build up, the voltage induced in the coil will momentarily reduce the coil current and thus retard the flux change. The effect of this action is to maintain a more constant closing pull on this type of magnet. The flux will, of course, build up in a very short time and will be a great deal more than is actually required to keep the magnet closed. This is why a coil protecting resistor can be inserted, if necessary, to keep down the coil wattage. Because of the nature of this closing force characteristic, the d-c magnet usually has a very high mechanical life.

One precaution often necessary on a d-c magnet is provision of a non-magnetic spacer, usually a brass strip a few thousandths of an inch thick, to keep the magnet from sealing and thus prevent it from sticking closed on residual magnetism.

Economical coil design becomes a problem of producing the necessary ampere-turns excitation with a coil which will run close to, but not exceed, the temperature limitation. This limitation is specified by NEMA and depends upon the insulation used. It is 85° C rise for an enamelled wire or impregnated coil (class A insulation) measured by the resistance method. If the coil is energized intermittently, more wattage can be put into it than if it is on continuously. Advantage is frequently taken of the duty cycle, so that the coil can be made as small as possible. Of course, coil size and magnet size are very much inter-related, since the magnet must be built around the coil, and the copper and iron cooperate in doing the work.

Force On A Conductor

We have reviewed how a magnetic flux can cause an induced voltage in a coil or produce a force within a magnetic circuit. One further important property remains. If a conductor carrying an electric current is placed in a magnetic field, a force is exerted upon that conductor. The force appears all along the conductor in direct proportion to the magnetic field strength and to the current. Its direction is at right angles both to the direction of the field and the direction of the current. Thus, in an electric motor a current is generally caused to flow in the rotating member, either by conduction, as in a d-c motor, or by induction, as in an a-c squirrel-cage motor. The reaction between this current and the magnetic field produced by the windings on the stator results in a tangential force and torque on the rotor.

In the case of the d-c shunt motor, the field is produced by the stator winding, which is connected to a constant voltage source. The rotor winding current is produced by connecting the rotor conductors, through a brush and commutator system, to a voltage which is generally the same as the field. The function of the commutator is to direct the current through the rotor winding in the proper direction so that the forces on all of the conductors add, even though half of them are in a field of one direction and the other half are in a field of the opposite direction. Therefore the current in any conductor is reversed by commutation as the conductor passes from one pole of the stator to the next.

Assume, then, that we apply a voltage to this d-c motor. A field is produced by the stator and a current flows in the rotor; thus we have a torque on the rotor. If, for the moment, we assume no connected load, friction, or windage, the torque will cause the rotor to accelerate. What speed will it reach? We can seldom consider one aspect of magnetism without running into others. In this case, the rotating winding will have a voltage induced in it which is dependent upon the speed of the rotor and the field strength. This voltage is in a direction to oppose the impressed voltage.

If we take into account a connected load, the motor will accelerate until the difference between the induced voltage and the impressed voltage will cause only enough current to flow in the rotor to produce the required load torque. At that point there is no unbalanced torque to cause further acceleration.

The induced counter voltage is directly proportional to the motor speed, the field strength, and the number of armature (rotor) conductors in series. The latter depends upon motor design, and, of course, is a constant for any given motor. The following relationship exists:

$$V - I_a R_a \cong S\Phi$$

or

$$S \cong \frac{V - I_a R_a}{\Phi}$$

where V=line voltage, I_a=armature current, R_a=armature resistance, S=motor speed and ϕ=field strength. For practical purposes $I_a R_a$ can usually be neglected and thus the speed is directly proportional to line voltage and inversely proportional to field strength.

A torque and horsepower relationship can also be developed. Torque is proportional to armature current and field strength as follows:

$$T \cong I_a \Phi$$

Horsepower is, of course, the product of torque and speed.

$$HP \cong T\,S$$

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IN 1846, twenty three years before the Golden Spike was driven at Ogden, Utah marking the completion of the first transcontinental railway, John August Roebling built America's first truly practical, wire rope suspension bridge. This bridge, which carried traffic across the Monongahela River for scores of years, stood as a silent testimonial to his confidence in a principle of bridge building which, in that day, was looked upon with considerable misgiving.

How much is this confidence worth to bridge engineers, and to humanity as a whole, today?

Had it not been for his confidence there would have been no Brooklyn, George Washington nor Golden Gate Bridges. Had it not been for your confidence in the company that bears this pioneer's name, there could have been no John A. Roebling's Sons Company.

Your confidence is valued above all of this company's assets. Every Roebling employee's job depends upon his ability to preserve that confidence by producing better products and by giving you better service than you can find elsewhere.

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THERE IS ONLY one real reason why electrical contractors who have used Roebling building wires specify Roebling again and again: they trust the product to perform consistently as predicted—dependably, safely, economically.

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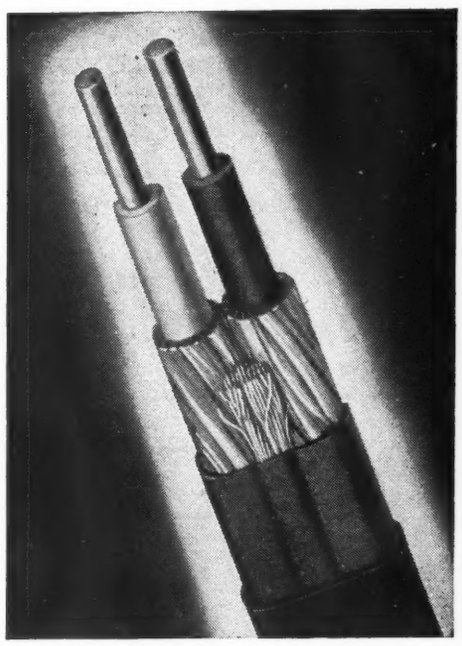

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Resistance in the rotor winding of a d-c motor is undesirable, since it is a source of heat loss and also means that the motor must slow down to produce more torque. That is, for a certain difference between line voltage and induced voltage, more current will flow in a lower resistance armature and more torque is available. Remembering that induced voltage is proportional to speed, we can see that a given additional load torque will cause less drop in speed in this case. Therefore, within practical limits, the armature resistance is kept low. This means that, until motor speed increases to build up the counter voltage, it is generally necessary to provide external current limiting resistors for a d-c motor.

A series field is often introduced in a d-c motor for stability. This field adds to the shunt field and is excited directly by the armature current. A greater load requirement will cause a stronger field and thus a greater torque will be produced with less increase in armature current. Assuming that a certain load torque is required, and that we have two motors with identical frames and shunt fields but that one has a series field, the series-shunt motor will produce this torque with a lower armature current due to its greater field strength but it will run somewhat slower for the same reason.

One other example of force on a conductor will be considered briefly; namely, the three-phase squirrel-cage induction motor. In this case the problem is quite different because we are dealing with alternating current, but the result is very much the same. The field windings on the stator of this motor are so displaced that, when connected to a three-phase source of power, a rotating sinusoidal field results. This phenomenon is illustrated in figure 6. The field sweeps around the air gap between the stator and rotor, penetrating into the magnetic rotor and cutting across the conductors which are imbedded in the iron and which are connected together by rings at either end. The speed of the rotating field depends upon the number of poles in the stator winding and upon the frequency of the power supply.

If the rotor is at standstill, and power is applied to the stator, the rotating field will produce induced voltages and currents in the rotor bars. These bars, being made of copper or aluminum and being almost completely surrounded by iron, have a certain resistance and reactance which will cause a displacement between the magnetic field and the current in the bars. Maximum torque would be produced if the current were either in phase or 180 electrical degrees out of phase with the flux because the product of these two vectors would then be a maximum. Actually, the induced voltage in the bars is 180 degrees out of phase with the flux so that, if there were resistance but no reactance in these conductors, the standstill torque would be a maximum for any given rotor current.

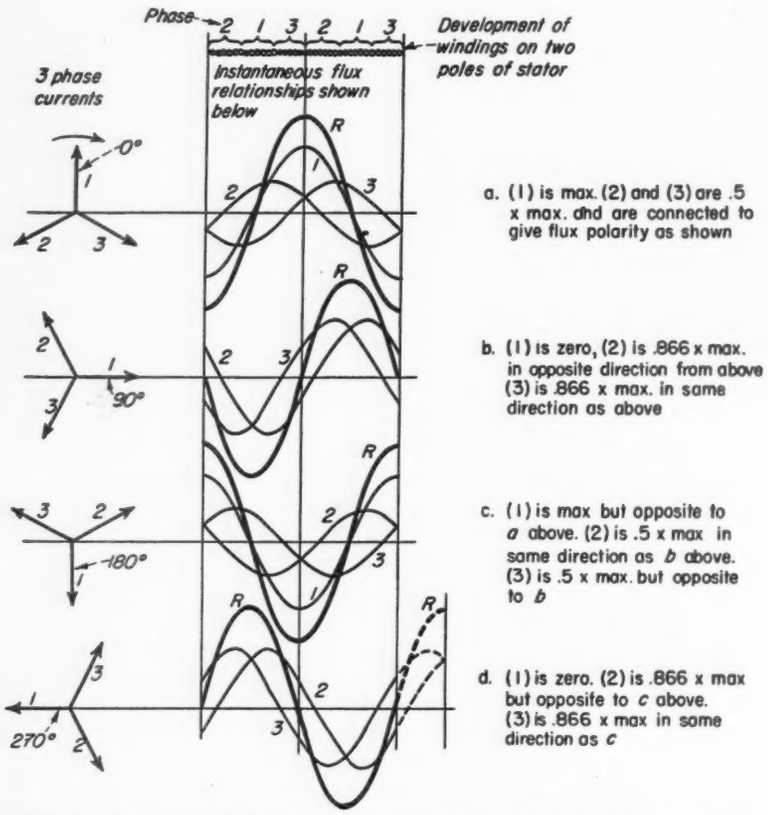


FIG. 6—A rotating field (R) of constant magnitude and form results from polyphase currents in windings displaced on the stator.

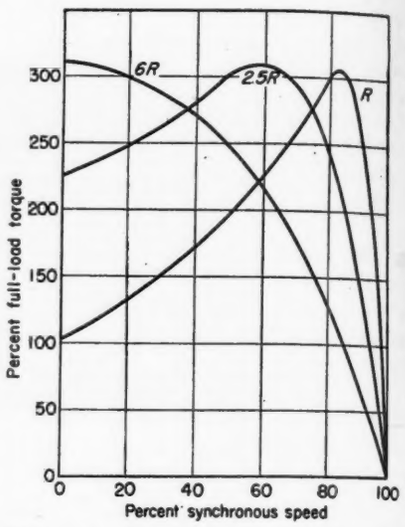
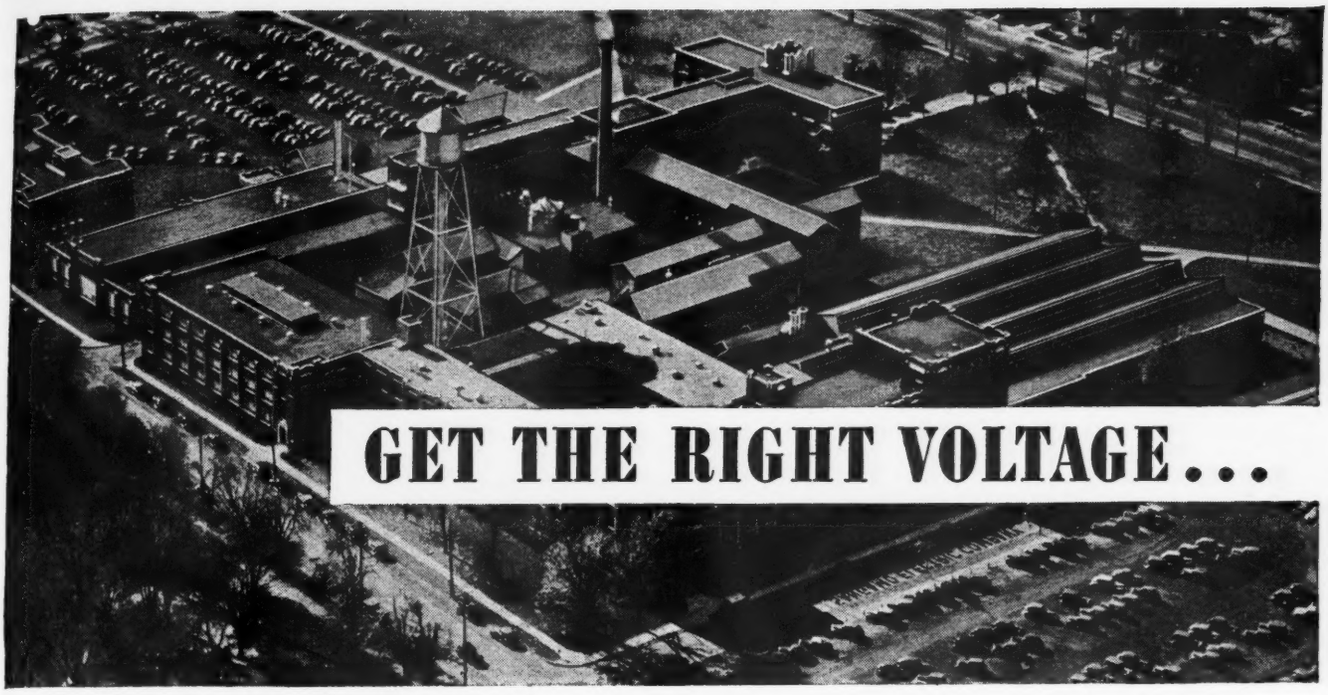


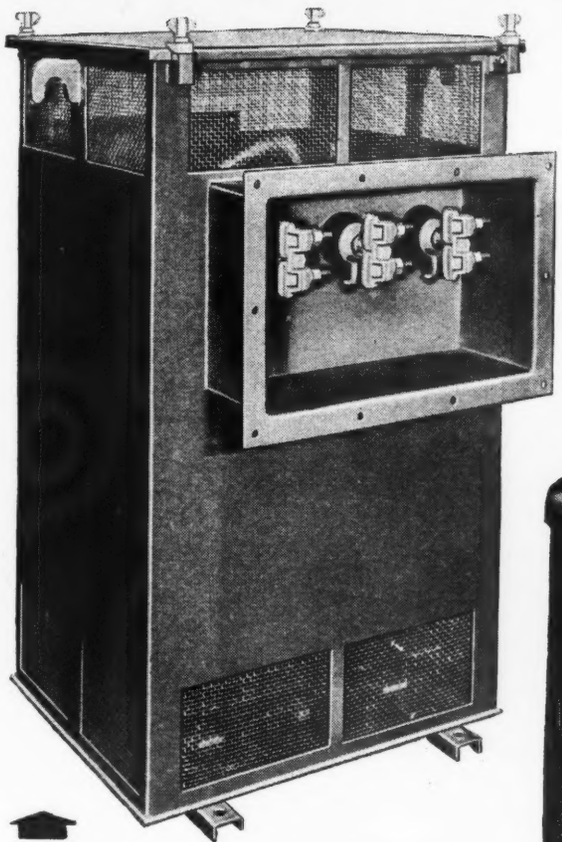
FIG. 7 — Approximate speed-torque characteristics for a typical induction motor showing relative values of total rotor resistance.

We will next consider the other impossible extreme, that of all reactance and no resistance in the rotor bars. The current would now be displaced from the flux by 90 electrical degrees. Multiplying the two vectors now gives us a torque in one direction for one half of the cycle and an opposite torque for the other half. The net torque, therefore, is zero if there is no resistance in the rotor conductors.

In the above analysis we have considered the rotor at standstill. As soon as there is rotation, the frequency and the magnitude of the voltage induced in the rotor bars decreases since the rotor has a speed in the same relative direction as the rotating field. The change in frequency of the rotor current has the effect of reducing the reactance and thus affects the phase relationship between current and flux. The effect of this change of magnitude and phase of the rotor current is to cause a change in torque as the motor comes up to speed. The torque-speed characteristics of this motor result from a combination of the above effects. The actual value of the maximum torque will be governed by the motor frame size; however the speed at which this torque will be obtained will depend upon the resistance-reactance characteristic of the rotor. Figure 7 shows a family of typical induction motor speed-torque curves.



GET THE RIGHT VOLTAGE...



A 100 kva two-winding air-cooled transformer, showing typical construction used in the larger units, which are designed for indoor service only.

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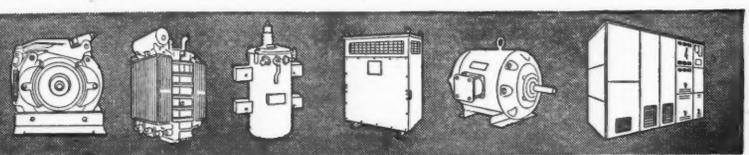

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QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay $5.00.

Reader's Quiz

D-C Motor Direction

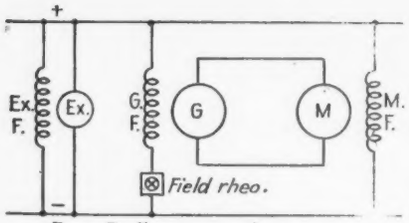
QUESTION 250—We have in service several machines which require direct current motors for their operation. As alternating current only is available, each machine has a vertical motor generator which supplies 220 volt power for the direct current drive motor. A separate exciter generator is mounted on top of the machine.

All but one of the machines give satisfactory service. About once a month, the maintenance man is called to this machine and finds the direct current drive motor running in the reverse direction. The exciter voltage polarity is always correct. Usually, after moving the generator brush holder slightly and cleaning the mica on the generator commutator, the direct current drive motor runs in the proper direction.

I would like some suggestions on how to permanently cure this trouble.—H.P.H.

A. TO QUESTION 250—Direct current motor direction can be changed by shifting brushes or changing leads of the armature or field, but not both. A loose brush holder may result in moving the brush holder enough to change direction. If the motor field is connected to one source and the armature to another source, then reversal of generator current direction in either source will cause reversal of motor direction.—H.S.

A. TO QUESTION 250—I assume it is supposed to always run in one direction. The accompanying sketch shows my understanding of the connections. An a-c motor (not shown) drives the generator (G) and exciter (Ex) at a constant speed and excitation is furnished to all the fields of the exciter, generator, and d-c motor from the armature of the exciter. The terminals of the motor are shown solidly connected to the terminals of the generator although sometimes a circuit breaker is connected in this



Ex. = Exciter armature
Ex F = " field
G = Generator armature
GF = " field
M = Motor armature
MF = " field

loop circuit. With full field on the generator, we get maximum speed on the d-c motor. Any reduction in motor speed is accomplished by increasing the resistance in the generator field. This arrangement is known as variable voltage Ward-Leonard drive. It would be possible to get reversal of the motor by the following methods; namely, one, by reversal of the motor field, and leaving the armature unchanged, and second, by reversing the applied voltage to the armature and leaving the field unchanged. HPH says the exciter polarity is always ok. Therefore, motor field polarity as well as that of the generator and exciter always remain the same. The trouble must, therefore, be in the armature circuit. Changing the polarity of the applied voltage to the motor armature could be done as follows:

(1) The applied voltage to the motor armature could be reversed by reversing the generator field excitation but since the exciter is ok., this is ruled out.

(2) Another method would be by reversing the connections between the generator and the motor without disturbing either field circuit. It is assumed that this loop circuit is permanently made and is therefore not the cause of the trouble.

(3) Since the correction is made by adjusting the generator brushes it looks as though these brushes get shifted one complete pole so as to reverse the polarity of the generator armature. If the brushes are held in the correct position so that they cannot get out of adjustment, the direction of rotation of the motor should not be affected.—R.F.E.

A. TO QUESTION 250—Probably the brushes on the troublesome generator are set close to the neutral of the commutator and high mica causes them to shift as the brush holder works loose if not tightened securely. If the commutator was undercut and the brush holder set and tightened securely, the trouble would be cleared up.—L.J.G.

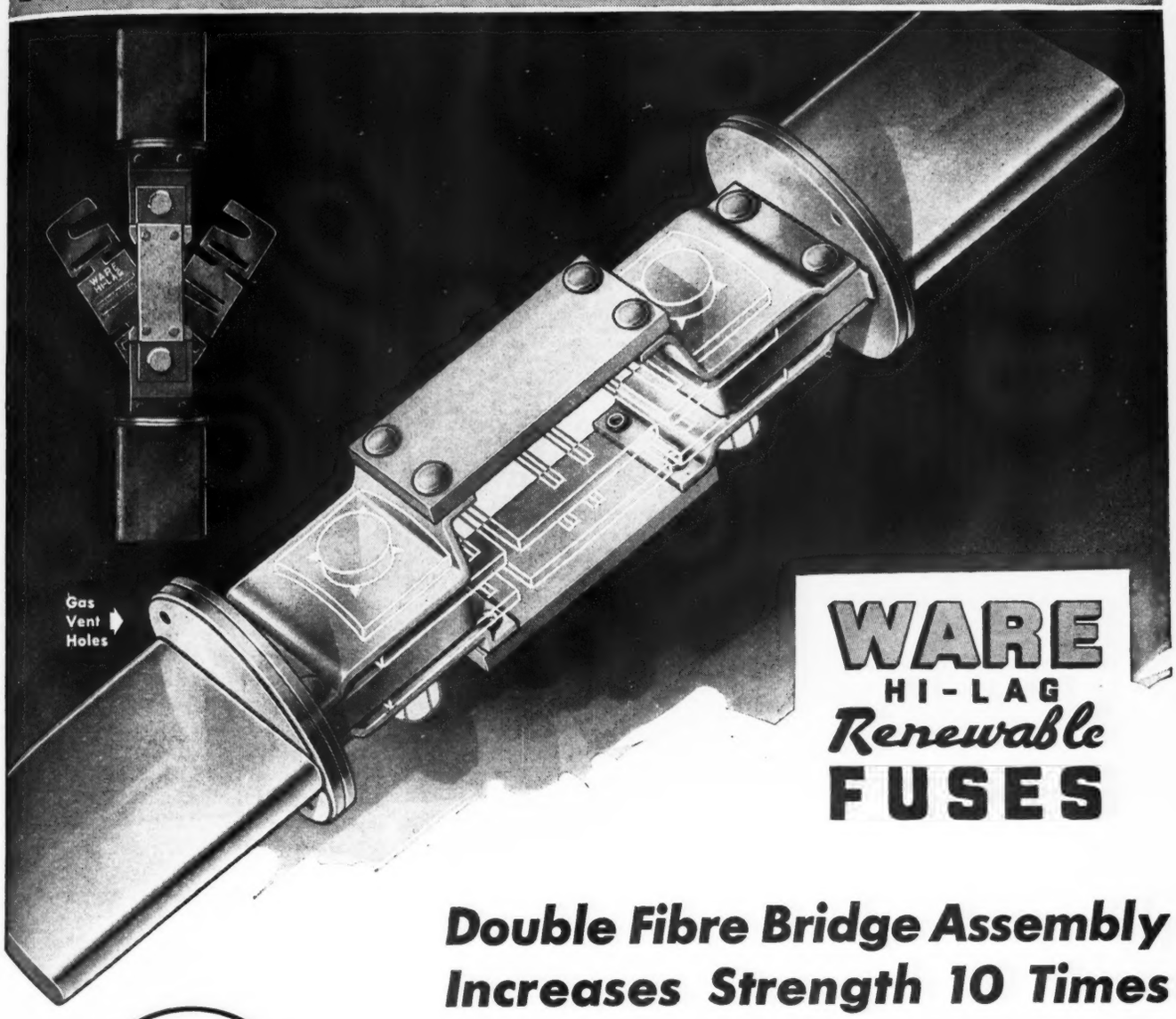
A. TO QUESTION 250 — As HPH has stated in his question, the maintenance man cleans the mica on the commutator and rocks the brushes of the generator slightly and the motor runs in the right direction. It is apparent that this is the trouble. I'd suggest boring another hole or two through the rocker ring and tapping holes into generator housing for bolts to hold brush-rigging securely after neutral point is found. To find correct non-sparking neutral point, put armature coil directly under center of interpole, trace coil to commutator bar and put bar under direct center of brush. Start machine and use low reading voltmeter. When normal load is on machine, put one leg of voltmeter on brush the other leg will single out the commutator bar that should be under center of brush when voltmeter reads zero. The only reason I can think of causing the commutator to have to be cleaned in this case is ring fire due to brushes being off neutral-point.—J.V.H.

Trolley Circuits

QUESTION 251 — We have *open or bare 110 volt trolley circuits in our plant and I would like to know what method to use to prevent the blowing of fuses on these circuits when a small tool or extension cord is shorted or grounded. Many tools are in use on these circuits fed with a trolley collector.—F.A.B.*

A. TO QUESTION 251—From the description given, the trolley wire installation involved here is outmoded and scarcely an ideal one.

LOOK TO WARE HI-LAG FUSE FOR PRODUCTION PROGRESS



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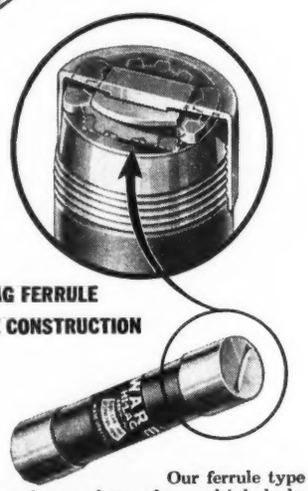

HI-LAG FERRULE FUSE CONSTRUCTION

Our ferrule type fuse has a heavy brass bar, which locks into open end ferrule, bridging fuse case. This bridge locks link to prevent twisting and cap tightens on new center contact. No sagging washers or twisted links to cause overheating.

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Bare wires present a hazard to both property and personnel. Consequently, its protection is of utmost importance. Hence, the principal problem is not one of how to keep the protective equipment from operating, but rather how to provide adequate protective devices which will function properly.

In the event of a fault, something must act as a circuit interrupting device; better a fuse which was constructed for that purpose rather than a part of the system which was designed for another purpose. If the conductors act as a fuse to interrupt the current by burning through, it will take much longer to replace the conductors than to replace a fuse—not to mention the hazards to property and personnel entailed when the wrong device opens the circuit.

Of course, all factors involved in the question are not known. The small motors may be fused at the motor. If so, there is no protection from the motor to the trolley. If a fault occurs between the motor and the trolley, the motor fuse will not operate, but the main fuse protecting the circuit should. Hence, protective devices should also be installed at the trolleys so that a fault between the taps and the loads will not disrupt the entire circuit.

Thus, the inconvenience of shutting down the entire circuit when the fault is on only one tap may be avoided simply by fusing the trolley. If this is not practical with the type of bare trolley circuit now in use, the only alternative is to scrap the present installation in favor of a more stable conductor system such as an inclosed bus bar duct system, several types of which are available. With this latter type of system, trolleys can be readily fused, and a much safer installation provided.—A.A.T.

A. TO QUESTION 251—I understand that your difficulty is that insulation failures in your small tools or in the flexible cords supplying them result in blowing the fuses protecting the bare trolley conductors. I suppose that the fuses are large enough to supply the number of tools which would be used normally and small enough to protect the trolley conductors. Using larger fuses might reduce the number of fuse blowings but would not give protection to the tools or the persons using them. The current should be interrupted in case of an insulation failure causing a short or ground and the better protection would be provided by a small fuse or circuit-breaker for each flexible cord. This could be supplied in the plug or in the trolley collector. Trouble in any tool will then result in opening the branch circuit to one tool.—J.E.W.

A. TO QUESTION 251 — In our plant we use an enclosed trolley duct with fused movable trolley collectors for each small portable tool and each overhead light.

These trolley collectors each have two individual fuses inside, therefore, both wires of the portable tool are fused in the trolley collector, giving each motor proper protection by using the correct capacity fuses, thus preventing the blowing of fuses on the main circuit.

I would suggest in your particular case that you use fused trolley collectors so as to protect the main circuit from a short or ground caused by a small portable tool. If you cannot fuse the trolley collectors you now have or get fused collectors for the open trolley circuit it might be much more efficient and economical to use enclosed duct with fused collectors as we are using in our plant—R.D.R.

A. TO QUESTION 251 — It seems your trouble could be reduced considerably by placing a small fuse at your trolley collector. You could use a screw type plug fuse, or if space will not permit, you may use an automotive type fuse and clip which requires a very small amount of space. To determine the size fuse, you can check with an ammeter to find the peakcurrent draw on each tool.

I believe it a good idea to stencil the size fuse to use on each fuse block or next to it. This will help in future fuse replacements.—F.F.

Dynamic Balancing In the Field

QUESTION 252 — What is an easy way of dynamic balancing of rotating machinery in the field?—H.S.

A. TO QUESTION 252 — The method used in dynamic balancing a rotating machine in the field depends to a large extent on its size. The rotor or armature is rotated by various means and weights are added on the periphery by cut-and-try methods until vibration and oscillation entirely disappear.

The rotor or armature of a fractional horsepower machine with a shaft mounted fan may be suspended horizontally in ball bearings and caused to rotate at rated speed by means of an air jet or by holding a running belt against its periphery. A heavier rotor or armature may be suspended vertically from a ball bearing. The entire suspension should be supported in such a manner as to be free to oscillate and vibrate. The rotor or

armature is then rotated at rated speed by means of a small motor belted to its periphery. Careful marking of the shaft while rotating facilitates the location of the portion to which weights are to be added. Weights are added or rearranged until a state of dynamic balance is reached.—R.G.C.

A. TO QUESTION 252 — The simplest and quickest balancing ways to set up on a job is made with two straight and smooth angle irons.

Set these angle irons the correct distance apart to permit the shaft of the armature to rest upon them while the open side of the angle iron rests on some wooden horses or blocks.

Next, level your angle irons and also level them to each other.

You now have a good balancing ways constructed in a half hour.—L.A.H.

Can you ANSWER these QUESTIONS?

QUESTION Q11—Can one check the brush rigging setting on a d-c generator with interpoles on full load? Or does the millivoltmeter method check for zero volts on the commutator have to be done only on no load with full voltage to get the proper brush setting, that is, when a generator has interpoles?—E.J.K.

QUESTION R11—I would like to know how you can take a 25 cycle fan and use it on a 60 cycle installation? We have a 25 cycle fan which we have taken out of a building which had 25 cycle current. I would like to know if we can use it in a building with 60 cycle current? We have tried the fan. It runs very slowly. Can anything be done to make it run at a normal speed?—I.F.

QUESTION S11—This question has come up recently in our testing unit, when taking load tests over weekly periods. Our "split core" current transformers are of the 250/5 ratio while the circuit we are concerned with varies from 300 to 700 amperes. It is impractical to open the circuit to place a variable range transformer in it. Now we do have a 15 amp. recording ammeter. Would it be practical and safe to use the 250/5 split core transformer with the above ammeter, thus overloading the transformer?—L.R.D.

PLEASE SEND IN YOUR ANSWERS BY AUGUST 15

LABOR COST VARIABLES

[FROM PAGE 69]

The more closely one analyzes the causes of labor increases, the better his chances are of selecting desirable jobs. By knowing the details of the causes he may also be able, in some degree, to correct them. Of all things, good mechanics should not be blamed for losses beyond their control. Those of us who have worked closely with electricians know that the large majority of them are high grade, hard working men and are entitled to all the moral support we have to offer.

Management and Labor Costs

In the foregoing treatment of the subject "What Determines Labor Costs," the problem was viewed from the angle of one preparing to figure an electrical construction project for a contractor thoroughly prepared to carry on the work. Effect of management was not discussed because it is largely an administrative problem, and one weighty enough to warrant separate treatment.

Two of the major functions of management are (1) proper selection and training of mechanics and (2) providing proper support for the man in the field.

Providing support for the men embraces many construction activities. In order for the mechanics in the field to show a high rate of productive efficiency, the management must supply ample and suitable plans, shop drawings, field engineering, supervision, tools and construction equipment. All of these must be forthcoming when and as needed.

Contractors who deliver the best jobs at the most economical cost confine their work to the limits of the organization. These limits are set by experience, engineering ability, mechanics available, tools, and the normal physical and financial capacity of the business. On two identical jobs one contractor may have a direct labor cost 25 percent less than another contractor who is not prepared to expeditiously carry on the work. Of course, the first contractor will in all probability have higher incidental job and overhead costs, but the cost of his completed job will be less than that for the second contractor. Up to a certain point, as job costs and overhead increase, the cost of the completed installation decreases.

The buying public, in general, does not know how essential astute management is to commendable work. There are those, however, who do stress this point when selecting electrical contractors. Usually they are architects, engineers, and managers who frequently buy electrical work. Persons buying only one job may never learn the value of management, or if they do, it is too late to be of any use.

An occurrence worthy of note before dismissing the subject of "Management and Labor" is the case where an owner decides to organize a crew and do his own work. Almost invariably the decision to do this is the result of faulty estimating and shortsightedness.

Because some mechanics are available at a lower rate than that paid by contractors to electricians, it is assumed that the saving on labor cost will be in proportion to the two rates. No consideration is given to the possibility of getting more productive labor per dollar paid, if the contractor's mechanics are employed. One may say that the owner can purchase materials at the same price as the contractor. Suppose by chance, he could; would he be able to buy as well? It takes training and experience to buy the right material in the right quantities and have them delivered at the right time.

Estimates, prepared as outlined above, are usually considered as being complete when the costs of material and labor are added together. No allowance is made for preparing plans and shop drawings, construction engineering, supervision, blueprinting, accounting, timekeeping, and all the other items of incidental job costs and overhead.

Surveys reveal that it is not unusual for industrial plants to have a labor burden (including all operating costs) of 100 percent. This is for work which is carried on year in and year out. It would seem incredible that anyone would want to say that he could undertake a new venture, and have material service and labor burden costs so low that they need not be included in the total cost of the project. Fortunately, this type of estimating is the exception rather than the rule.

Analysis of cost show that if the properly qualified contractors are available, owners can benefit by taking advantage of their services. Managers of efficiently operating plants know this. They know also that if they are to maintain the efficiency of their organizations, operations which interfere with the regular routine must not be introduced.

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IRVINGTON VARNISH & INSULATOR COMPANY
Irvington 11, New Jersey

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Motor Shops

Carbon Dust Remover

During the war, carbon dust was literally and figuratively "getting in the hair" of soldier-technicians. In the generator repair shop of an Air Service Command depot, one G. I. generator repairman decided to do something to keep the black stuff out of the air and away from their work benches. His solution is well illustrated in the accompanying picture.

New carbon brushes are seated properly by placing a strip of sandpaper around the commutator end of the generator and rotating the armature. The particles of carbon gathered in the process were blown free of the generator by a stream of compressed air and would finally settle in the hair, eyes, ears, noses and throats of the soldiers working nearby.

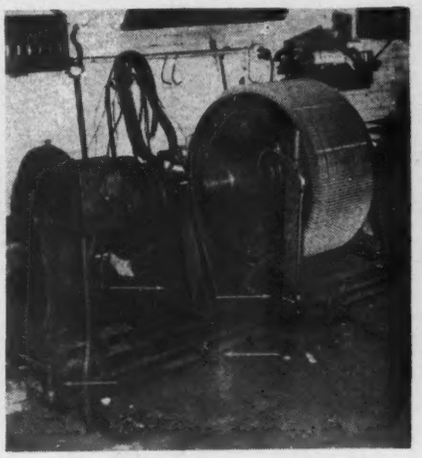
Corporal Gordon S. Buck, of Naples, Maine, a generator repair specialist at his base, analyzed the problem and set out to find a solution. He found a broken down vacuum cleaner, which gave him an idea. Salvaging and repairing this cleaner, Corporal Buck attached a cap to the hose, which was made to fit over the commutator end of the generator. The compressed air hose was inserted through a hole in the cap, to blow the carbon dust off the sandpaper. The suction of the vacuum cleaner automatically draws off this carbon dust, and into the dirt bag.

A discarded vacuum cleaner was repaired and used to remove carbon dust from generators being repaired in an Air Service Command depot by Corporal Gordon S. Buck, of Naples, Maine.

Banding Machine For Large Armatures

Large armatures, measuring up to four feet in diameter, can be banded on a shop-assembled motor-driven machine designed and used by the A-C Motor Service Company of Jersey City, N. J.

The base of the assembly is composed of two 8-inch I-beams securely fastened in parallel to supporting iron channels which, in turn, are bolted to the concrete floor slab. At one end of the I-beam frame, an elevator worm and gear assembly is rigidly mounted. Provision is made (by belt drives) for either one of two motors (3 and 5 hp.) to turn the worm shaft. The smaller of the two motors runs at 1800 rpm. while the larger unit has a speed of 1200 rpm. After closing the power switch, the motors are controlled by means of a foot pedal (A) that rotates a horizontal shaft and activates the switching lever (B).



Large diameter armature is banded on shop-assembled machine in shop of A-C Motor Service Company, Jersey City, N. J. Shafts may be rotated at varying speeds by motor-driven worm and gear assembly. Binding wire under tension runs from tension shaft to pivoted pulley arm and thence to armature lip.

Sturdy pillow blocks, resting on the parallel I-beams, support the armature to be banded. The pillow blocks can be moved along the beams and securely fastened at any desired location by means of bottom clamping plates and bolts (C). Various collaring arrangements transmit rotational action from the elevator gear shaft to the shaft of the armature resting on the blocks. Banding wire, from a horizontally-rotating reel mounted behind the assembly, runs around a tension shaft and is carried across to the front of the assembly to the base of a pivoted pulley arm (D). The wire then rises to a second 3-inch sheave immediately below a guiding handle. Like the pillow blocks, the pivoted pulley arm can be moved along the beam base and fastened where desired. This desired point is directly opposite the lip being banded.

As the armature is slowly revolved, the banding wire is pulled from the upper sheave in the pulley arm. Accurate banding is possible by moving the guiding handle as the operation continues. Tension may be varied by adjusting pressure on the tension shaft. Speeds may be altered depending upon the size of the shaft and the amount of power required to turn the worm-gear assembly. The unit is of definite aid in handling large jobs. Armatures greater than four feet are banded on the job.

Adjustable Truck Hoist

An efficient means of loading and unloading motors on the delivery truck is a "must" for the modern electric motor repair shop. Gone by the boards is the old system of using "skid planks" and plenty of back-breaking manual labor. In its place we find various types of truck-mounted hoisting mechanisms—all designed to facilitate one-man handling of equipment.

Typical of the units being built by many shops throughout the country is that which the M. J. Torrence Electrical Supplies Co., Inc., Rock Island, Illinois, motor service shop, has mounted on its delivery truck (see Fig 1). Designed by Joseph J. Beals of the Torrence Company, and con-

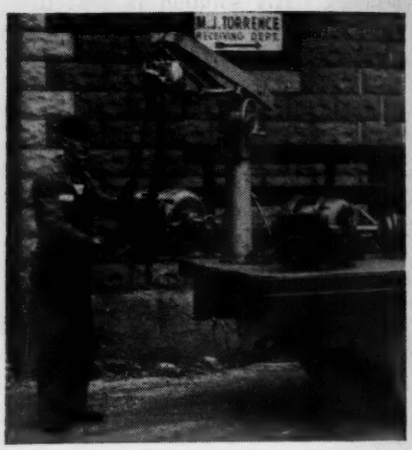
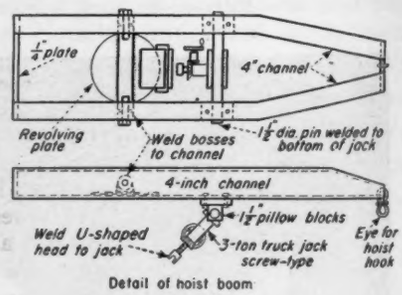


FIG. 1—One man can easily handle motor pick-ups with this adjustable truck hoist. Vertical adjustment of rotating boom permits access to low-clearance areas.



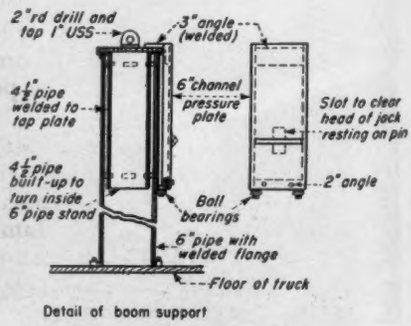


FIG. 2—Design details of hoist construction. Only scrap parts and material were used.

The Cutler-Hammer
TYPE MO 4 MULTI-BREAKER

Cutler-Hammer Engineered and Manufactured to Cutler-Hammer Standards of Dependability.

This new small size Multi-Breaker measures only 5″ x 7″, yet has 4 poles, with circuit ratings of 15, 20, 30 amperes, and has thermal and magnetic trip heretofore found in industrial type Multi-Breakers. The magnetic trip operates instantly on short circuits. The thermal trip holds on harmless overloads.

The two top or two bottom poles can easily be connected for double pole circuits by using the tie bars provided.

The Cutler-Hammer MO 4 Multi-Breaker is available for flush or surface mounting. It is engineered and manufactured throughout to world famous Cutler-Hammer standards making it unusually rugged and dependable.

There is a wide market for the Cutler-Hammer MO 4 Multi-Breaker in new housing of every type, stores, homes, offices, factories, schools and shops. In some cases the MO 4 can be used as a service entrance switch, in other cases as load center protection. Feature and show the Cutler-Hammer MO 4 Multi-Breaker at every opportunity. CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin.

CUTLER-HAMMER
MULTI-BREAKER
C-H

structed entirely of scrap metal and parts, the unit took second prize honors in last year's NISA Award Contest. Discussion of this shop idea is by permission of NISA headquarters.

Unique features that placed this hoist design in the prize winning category are the full 360 degree horizontal swing and vertical adjustment of the boom. This latter feature — accomplished through the use of a 3-ton, screw-type, truck jack — was added to facilitate handling motors on premises with low door or areaway clearances where high overhead mechanisms were a hazard.

Figure 2 illustrates the basic design of the unit. The boom is fabricated from two lengths of 4-inch channel iron tapered inward at the front to accommodate a hook-eye for a chain hoist. It pivots on a trunnion-type mounting consisting of four round steel bosses (two welded to the inside of the channels; two welded to the revolving top plate of the pipe stanchion) and two threaded pivot bolts. The channel bosses have a clear bore through which the pins slide; the top plate bosses are drilled and tapped to receive threaded end of pin bolts.

Vertical adjustment of the boom is provided by an inverted truck jack with its base welded to a 1½-in. diameter shaft mounted by pillow blocks to the underside of the channels. A U-shaped head welded to the jack screw engages a pin on a pressure-plate which rides on the outside of the supporting pipe stanchion. The boom is raised or lowered by turning a hand wheel attached to the screw jack.

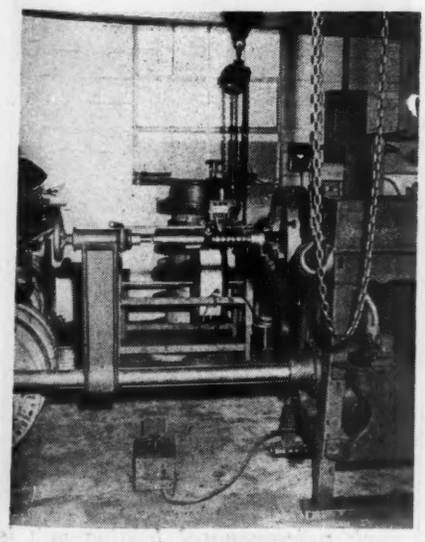
A length of 6-inch pipe serves as the support for the hoist boom, actual height depending upon door clearances on customer's premises and the necessary truck clearance. A simple telescopic pipe insert with an exterior pressure-plate provides full 360-degree rotation. A length of 4½-inch pipe (built up near both ends to fit inside the 6-inch pipe standard) is welded to a steel top plate which rests on the top flange of the boom support (see Fig. 2). Also welded to the top plate is the exterior pressure-plate consisting of a 6-inch channel (same length as 4½-in. pipe insert) welded to a 3-inch angle at the top and equipped with two ball-bearing rollers at the bottom. The forked head of the boom jack rests on a round pin attached to this outer plate. This arrangement takes care of whatever load stresses might be encountered and still admits free rotation of the boom. A flange mounting at the base and two flat steel braces rigidly support the 6-in. stanchion. A chain hoist hooked on the boom eye completes the assembly.

Transformer Winder Has Many Uses

Manual skill, resulting from experience and training, cannot be stressed too strongly as a necessary qualification of the valuable shop operator. Emergency jobs are often possible because basic theory and practical know-how can accomplish many tasks with a minimum of modern equipment and specialized tools.

But although it is worth much to be able to perform jobs with unaided manual effort, knowledge and patience, the possession and use of modern equipment and tools likewise is an asset which should not be underrated when jobs can be performed faster, safer, more easily, uniformly and economically with their use. Where initial cost, maintenance and operating charges can be distributed over many similar operations, it is in the interest of economy and efficiency to practice modern methods. Many machines, purchased for specific jobs, can later prove doubly valuable by performing additional jobs other than those for which they were designed.

An example is a large transformer winder installed in Lockwood's Electric Motor Service shop, Trenton, N. J. Not only is it used for its intended purpose but it also serves for banding large armatures, turning down commutators and as an auxiliary lathe and coil winder. Centrally located in the shop, adjustable for length and chuck diameter, served by an overhead monorail chain hoist and foot-pedal operated, it is used for jobs ranging from large transformer coils down to the small railroad controller coil pictured in the illustration. George R. Lockwood believes that modern equipment not only improves plant efficiency but is an important sales point.



Transformer coil winder has many additional uses.

Sectional Heat Units Cut Baking Cycles

Sectional, movable banks of infra-red heat lamps are slashing the duration of drying and baking cycles in Lockwood's Electric Motor Service shop, Trenton, N. J.

The movable sections, of light channel steel construction, are castor mounted and support six banks of drying units, each bank consisting of six 250 watt infra-red lamps. The top and bottom horizontal rows, hinged to the main assembly, can be easily adjusted so that heat from the lamps in these rows can be directed forward in horizontal planes or at angles towards a focal line parallel to the vertical midpoint of the assembly. At either end of the rolling sections, hinged reflectors (each 2 feet in width and measuring the full height of the assembly) are mounted. When used as single units, these reflectors are used to direct heat towards the object being baked. When two assemblies are used as a single unit, the reflectors confine the heat between the ends of the units and overhead roofing shields retard the heat from rising from the heating zone. Since each wing reflector and each roofing shield is two feet in width, the distance between sections can be adjusted between this 2-foot minimum and the combined 4-foot maximum. Each lamp bank in each section is separately controlled by switches mounted at the rear of the assemblies.

Tar paper on the shop floor catches the small amount of surplus insulating varnish that drips from the units being baked. When this paper becomes coated, it is discarded.

Each roller-mounted heating unit is equipped with six banks of six 250-watt infra-red lamps.

Modern Lighting

Light Augments Architecture

In the Brass Rail restaurant and bar, Pittsburgh, Pa., the lighting equipment used to produce a very comfortable high intensity of illumination is artfully concealed throughout. This installation is a combination of direct and indirect lighting, and is thoroughly in keeping with the unusual architectural and decorative treatment.

The exterior of this "snack bar", as it is popularly called, is illuminated by nine 200 watt silver mirrored glass reflectors recessed in the soffit over the corrugated glass front (Fig. 3). These reflectors are recessed above stippled diffusing glass roundels installed in hinged frames for ease in maintenance and relamping. Use of these reflectors on the exterior serve a double purpose. They provide high intensity lighting which attracts passersby, and also light the corrugated glass softly, so that it produces a cheerful effect on the interior.

Glass enclosed fluorescent lamp troffers are recessed behind settees and over the service counter hood to provide indirect lighting throughout the general area. These produce a startling result on the ivory colored acoustic ceiling, which reflects the indirect illumination in such a manner as to cause the ceiling to appear as a translucent light source (see photo, Fig. 1). Other troffers installed to provide indirect lighting are concealed behind the cocktail bar and below the corrugated glass facade of the balcony. White fluorescent lamps are used in all troffers, except at the balcony, where blue fluorescent lamps add an artistic treatment.

Direct lighting glass enclosed troffers are installed over the mural behind the bar, and in the false ceiling beams over the indirect lighting elements. These troffers were not lighted

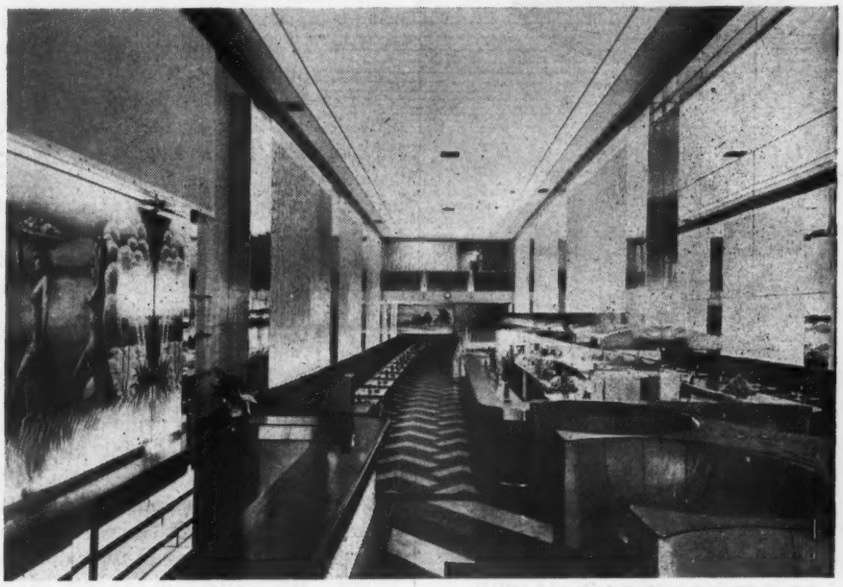


Fig. 1—Light is skillfully used as part of the decorative treatment at the cocktail bar, and throughout the interior of this "snack bar."

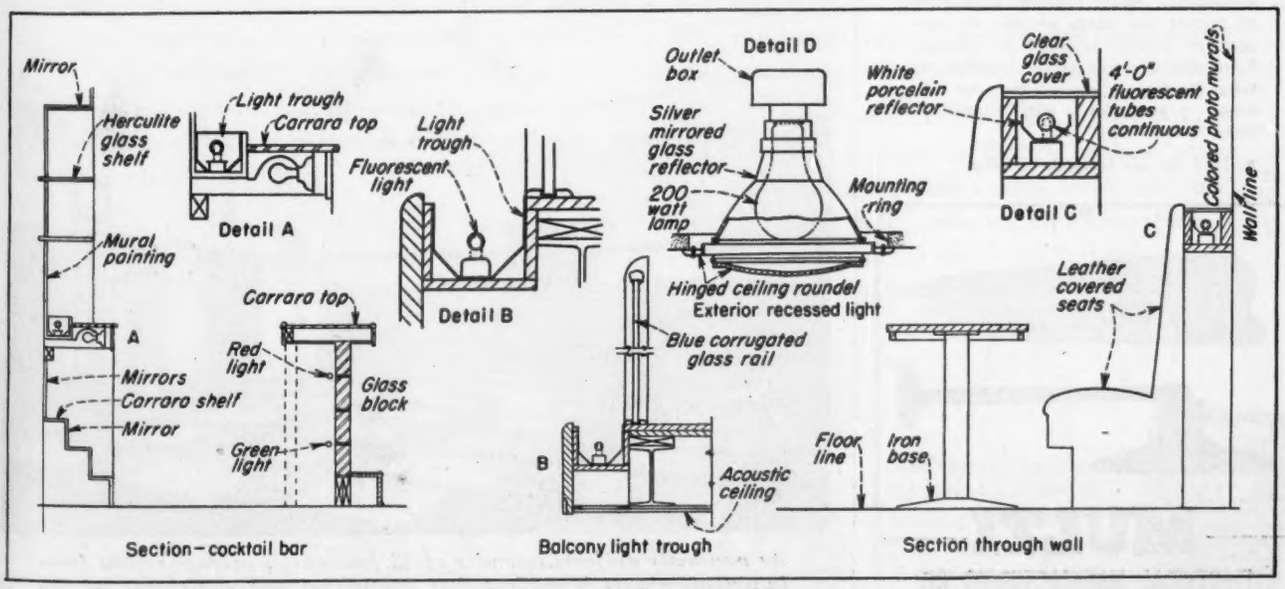


Fig. 2—Lighting details and cross sections through furniture and structural elements illustrate how lighting equipment can be effectively concealed from view.

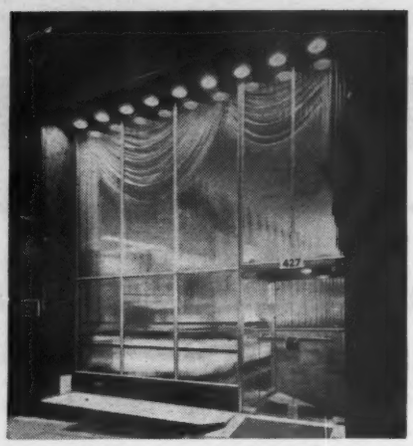


Fig. 3—Exterior lighting on the corrugated glass front of the Brass Rail Restaurant, Pittsburgh, Pa., adds sparkle and glitter which attracts attention of both old and new customers.

when the photograph shown in Fig. 1 was made. Direct lighting from similar troffers is also applied beneath the service counter hoods.

An artistic and colorful effect is provided by light at the cocktail bar. Incandescent filament lamps are concealed at the top of the display case behind the bar. This case is backed with mirrors. Sparkle and lustre is thus accentuated in the displays of wines and bottled goods. The glass block forming part of the front of the bar itself is also illuminated from behind by two rows of fluorescent tubing, one red and one green. The light from these lamps blend and sparkle through the glass, providing a very pleasing and colorful effect.

The average maintained level of illumination from the indirect units only is 30 footcandles. An additional 45 footcandles is supplied by the direct lighting equipment.

This installation dispels the bugaboo opinion that lighting levels in restaurants and cocktail lounges must be very low in order to be comfortable. In fact, the cheerful atmosphere created by the higher intensities is a key attraction to customers. It accents the cleanliness of the place, and subtly influences people to return again and again.

Frank Harris Smart, Smart and Braziell, was the architect for this job. He planned the lighting as an integral part of the architecture and decorations with a particularly keen understanding of the use of light as a medium of expression. All equipment used was manufactured by the Pittsburgh Reflector Company, and was installed by the Burke Electric Construction Company, electrical contractors.

School Selects Model Lighting

Many schools have made exhaustive and detailed studies during the past two or three years to determine the type of lighting equipment, and the color and reflection factors of paints, best suited for lighting in typical classrooms. Much attention has been given to the quality of the lighting, as well as the quantity, which is most desirable for comfortable vision. The Wilson High School, St. Paul, Minn., has recently completed such a study, in which four classrooms were used for experimental test purposes. The room and installation finally chosen as representing the best solution to this

An unusually uniform intensity of 42 footcandles average results from luminous-indirect Wakefield Star continuous row equipment in this model lighted classroom. Ceiling and side walls were freshly painted with high reflection factor paint.

If they want to dehydrate  cod fish, dry a finish  , bake ceramics  , cure hides  ...or what have you...

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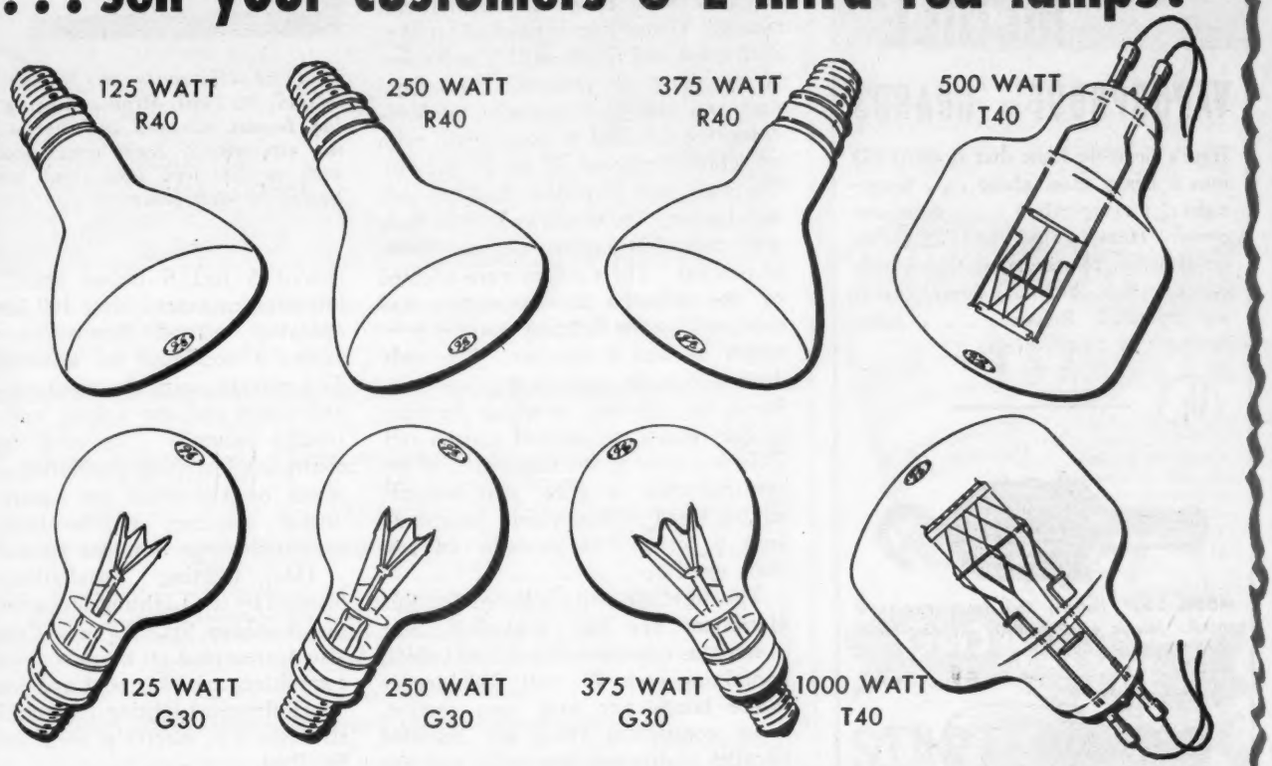

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Remember, whatever infra-red lamps your customers need, General Electric makes 'em all! The full line includes sizes from 125 to 1000 watts, in both reflector and clear bulb types. Better stock up now! For full information call your nearby G-E Lamp district office.

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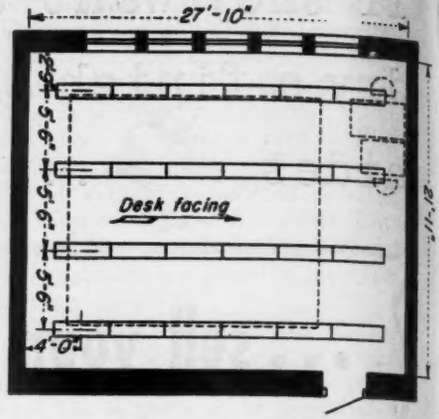
problem is reviewed below. It is interesting to note that this solution closely approximates solutions selected by other schools and lighting committees in various parts of the country, all working independently.

The classroom in which this test was conducted is 21 feet 11 inches wide and 27 feet 10 inches long, with a 12 foot 4 inch ceiling height, slightly smaller than the average classroom. The room was repainted throughout to provide higher reflection factors, better contrast ratios and higher efficiency. The ceiling is finished an eggshell color and finish, with a reflection factor above 80 percent. The front wall and side wall opposite the windows are finished a dove gray, with reflection factor of 50 to 55 percent. The rear wall is yellow, and the side wall housing the windows is blue, both with reflection factors slightly above 50 percent. These colors were selected by the school's art instructor, and approved by the lighting committee of which he was a member. The only dark spot in the room is the door leading to the corridor, in which the sides of the recess are painted a deep red. This was done at the suggestion of the art instructor in order that students having short-sighted vision "might secure a bit of red in order to rest their eyes."

The lighting units selected for this classroom are the Wakefield Star continuous row luminous-indirect units, containing two 40 watt 3500-degree white lamps per four foot section. Four continuous rows are installed parallel to the window wall, and are



Plan of classroom in Wilson High School, St. Paul, Minn., showing lighting layout selected by special lighting committee. Each continuous row unit is 24 feet long and contains twelve 40 watt lamps.

spaced 5 feet 6 inches apart. The intensity, measured after 100 hours of operation, was 42 footcandles. This shows a coefficient of utilization of 23.3 percent, with the equipment new and clean and the ceiling and walls freshly painted. The total wattage consumed, including auxiliaries, is 2400 watts, or 3.94 watts per square foot. Initial efficiency is therefore 10.6 footcandles per watt per square foot.

This lighting installation was planned by the Lighting Department of the Northern States Power Company, also represented on the school lighting committee, and was sold and installed by Hoffmann Lighting Electrical Construction Co., electrical contractors of St. Paul.

Standard Units Light Department Store

Standard fluorescent and incandescent lighting units were used to light Harvey Bros. department store in Omaha, Nebraska. These have been combined so that the resultant high intensity illumination is well balanced, or of excellent *color quality* for displaying and selling merchandise. The light on the displays is not as "yellow" as if all units were incandescent. Neither is it as "cold" in appearance as if all units were fluorescent. It is of proper color to show the merchandise approximately in its true shades and texture as it would appear under average daylight.

An excellent example of industry interdependence was demonstrated in the design and sale of this lighting installation. The store manager asked the Nebraska Power Company, electric utility, for a planned lighting layout for the store, consisting of first floor and basement. Two layouts were made: one based on cove lighting at the suggestion of the general contractor; the other based on standard catalogued units, normally available from wholesalers' stocks. The store owners decided on the layout using standard lighting units. The job was installed by National Electric Company, Omaha, electrical contractors, and the fixtures were purchased through the General Electric Supply Corporation, electrical distributors of lighting equipment.

Lighting units used consisted of three manufacturers' products, each selected to do a specific job. Reflectors for the two display windows were Pittsburgh Reflector Company's units Nos. 54-2 and 99-2. Incandescent units for the main sales area of first floor and basement were Holophane Company's Correctalite, No. 5540. Fluorescent units for the main sales area in the basement and on the first floor were Wakefield Brass Company's "Grenadier" standard two 40-watt lamp units, in four and eight foot lengths.

FIG. 1—Eighty footcandles of illumination from standard incandescent and fluorescent units is provided on the main floor of Harvey Bros., department store in Omaha, Nebraska.

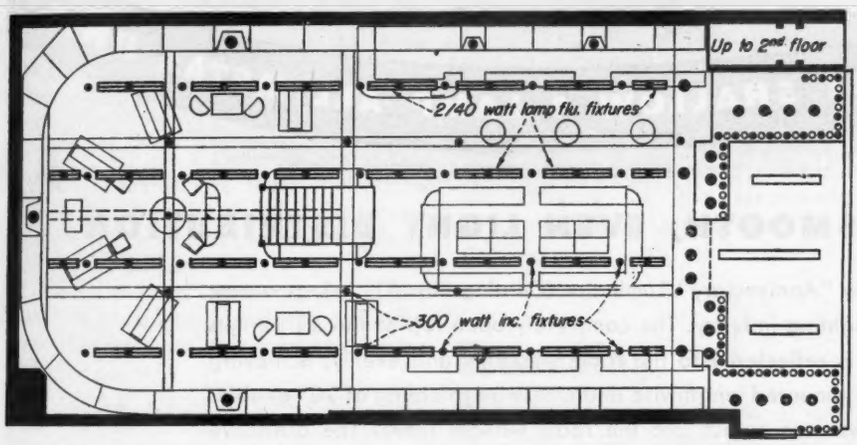


FIG. 2—Planned lighting layout utilizes Pittsburgh silver mirrored glass reflectors in show windows and Wakefield "Grenadiers" and Holophane Correctalites in main sales area.

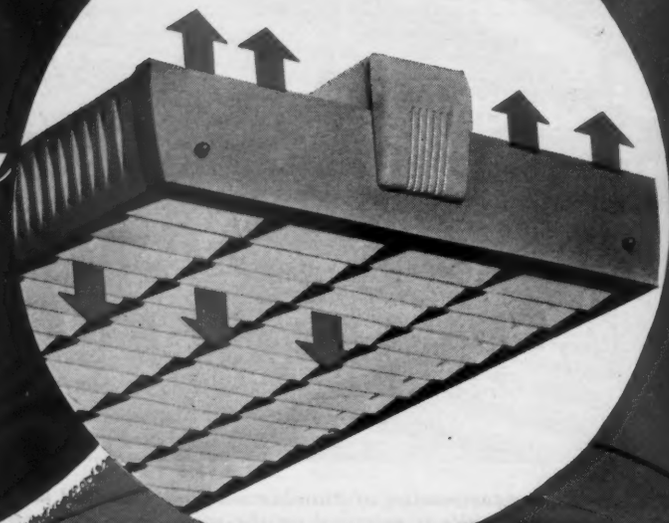
The planned lighting layout used on the first floor is shown in Fig. 2, while a view of the first floor is shown in Fig. 1. The layout for the basement floor is similar. With all lights turned on, the interior illumination averages 80 footcandles. Use of the fluorescent units only produces 45 footcandles, while the incandescent units only produce 35 footcandles. Inbuilt type Holophane units were used in the fitting rooms, while Pittsburgh No. E-150-5 and No. E-230-5 flush louvered units were used in the ceiling of the first floor near the entrance, to provide additional light at this point.

This installation also serves to illustrate the fact that *planned lighting* can be achieved through the use of typical production-run lighting equipment, units which are mass produced and sold and stocked through normal distribution channels.

Albert A. Fox, Office of Housing Expediter, Wash., D. C., (left) was conference chairman of the Illuminating Engineering Society's East Central Regional Conference, Washington, D. C. He is shown here at speaker's table during banquet, with Samuel G. Hibben, Westinghouse Electric Corporation, Bloomfield, N. J., guest speaker, who gave a romantic illustrated story of the history of artificial lighting in the White House.

The Curtis Anniversary Luminaire

CATALOG No. 51



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Outstanding Curtis design and engineering make the "Anniversary" luminaire applicable to a wide variety of lighting jobs, for use as individual units or in continuous lines. Simple to install, easy and inexpensive to maintain, the "Anniversary" luminaire brings you decorative beauty, quality construction and assures long satisfactory service.

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CURTIS Lighting, INC.

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Answered by
F. N. M. SQUIRES and GLENN ROWELL
New York Board of Fire Underwriters
Chief Inspector
New York, N. Y.
Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

Questions on the Code

How Many Building Service Switches?

Q. *An "L" shaped building is located on a street corner, with stores facing on both streets. A bank occupies the corner and has no cellar under it, but a cellar is located under one of the stores on one of the streets. The present service equipment is in the cellar and is accessible only to the occupant of the store above it. How may current be supplied to the bank and other stores?—H.L.G.*

A. To get a clear picture of this problem we must understand the terms "service drop" and "service entrance conductors", over which there is often confusion.

"Service drop" is the portion of the service conductors from the pole line on the street to the first attachment on the house.

"Service entrance conductors" are the portion of the service conductors from the point where they are attached to the "service drop" to the connection to the service equipment (service switch and cutout, not including the meter).

Rules 2301 and 2321 require that there be only one service box to a building except under certain conditions, but permit the connections of more than one set of "service entrance conductors" to that "service drop".

One of the conditions under which an exception may be made takes care of our problem. This is found in Subparagraph 231e which states that *"by special permission,* in multiple-occupancy buildings where there is no available space for service equipment available to all the occupants", more than one service-drop may be used.

Of course one way which does not require special permission, may be followed, and quite often is. That is, to provide one service-drop of ample size and to connect this to a set of service conductors running along the outside of a building from which service entrance conductors are tapped off for each occupant. Another method which is sometimes used, is where several sets of service entrance conductors are all connected to the service-drop at one point (this often makes a messy looking job).

In the case of where service conductors run to one tenant's service equipment in his building, which therefore may not be accessible to other tenants, sub-sets of service entrance conductors may be tapped to supply side of the service equipment and run as service conductors to the other tenants.

This last possibility depends of course, on several factors such as the capacity of the service-drop, ownership of the service-drop, etc.—F.N.M.S.

Grounding

Q. *I have wired a number of farms on R.E.A. lines and recently have received several rejection slips from a new inspector because I grounded the frame of the motor on the water pump to the well casing. This would seem to be far better ground than any driven ground rod, but the inspector claims that the use of the well casing is forbidden. Is this a local rule or is it part of the new Code?*—T.L.R.

A. This is a local rule and a most excellent one on farm properties where the water system extends to buildings housing livestock, especially where the ground is frozen during winter months. Numerous instances are on record where partial faults in motors on well pumps have energized the drinking cups in cattle barns resulting in some instances in loss of livestock and in many others in reduced milk supply. Livestock are most susceptible to electric shocks, and stray currents even of extremely low milli-amperage if present on the drinking cups will materially affect the amount of milk a cow will produce. It, therefore, is necessary to isolate the farm electrical installation from any water system entering these barns even though the well is quite some distance from the barn. On one particular instance 18 head of registered stock were killed when the installation in a ⅓ h.p. motor on a pump jack failed. The well was about 200 feet from the barn and the water pipe between the barn and well was buried about six feet in the earth. The motor frame was grounded to the well casing, but current followed the underground piping to the drinking cups. An investigation revealed frost in the ground about the pipe which would offer some insulation, and the resistance to earth in the well casing was sufficiently high to charge the piping in the barn. This peculiar problem is not confined to cattle as instances are even known of loss in egg production due to a slight charge on the water fountain on a chicken farm—G.R.

Type T Conductors

Q. *I plan to run some 500,000 CM feeders and the only kind I can obtain are known as Type T. When I questioned the local inspector, he told me that he could not approve their use in conduit and the local ordinance requires the use of raceways. What can I do and still comply with the Code and local ordinance?*—D.K.P.

A. The Code prohibits the use of conductors in sizes larger than 4/0 in conduits because the weight of the copper in 250,000 CM and larger sizes is such that it is likely to force itself out of center when confined within a thermoplastic insulation. Any thermoplastic material softens under heat and should the copper leave its center position the dielectric value of the insulation drops until a fault occurs. You will note that under Section 3102 Type T and TW conductors are made in sizes up to 2,000,000 CM

but that they are approved for general use in sizes from No. 14 to 4/0 only and that sizes above 4/0 are approved only for open work.

If you are unable to obtain Types RH or R in the 500,000 CM size and can get Type T in 3/0 two Type T conductors run in multiple will carry practically the same load as a single 500,000 CM Type R conductor.—G. R.

Multi Wire Circuit

Q. *We are planning the installation of continuous trough lighting in an office building supplied by a four wire three phase service. The fixtures we propose to use are designed to be used as a raceway, but we have been advised that the Code permits only one circuit being placed in such a raceway. Is that true?*—M.A.L.

A. Yes, but in your case it might be a four wire branch switch. Section 4150 reads as follows: "Fixtures shall not be used as a raceway for circuit conductors unless the fixtures meet the requirements of approved raceways, except that the conductors of a single branch circuit may be carried through an installation of fixtures approved for end to end assembly to form a continuous raceway." Then recently an official interpretation was issued under No. 287, which stated that the reference to a single branch circuit did not mean a two wire circuit. Therefore you could use any multi wire circuit permitted by Section 2111. —G.R.

Old vs New Carrying Capacity

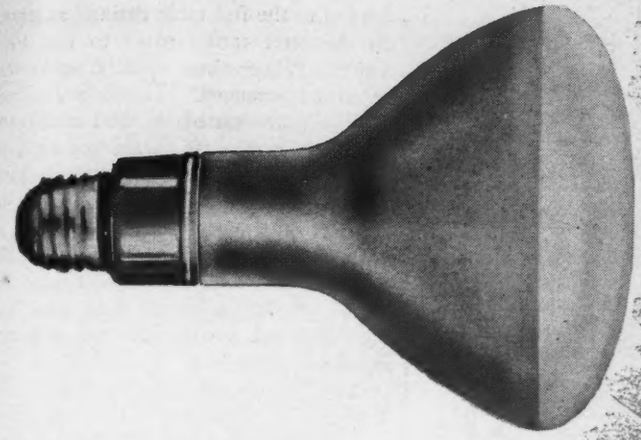
Q. *An additional load is planned to a 500,000 C. M. Type R feeder installed in 1937 at which time the N.E. Code allowed a 400 ampere carrying capacity.*

Should the carrying capacity of this feeder be based on the 1937 ampere rating or should the 1947 rating of 320 amperes be enforced?

It is presumed a connected load of almost 400 amperes will result with the additional load, which, if the 1947 Code rating is applied, would call for new feeders of 750,000 C.M. at a considerable increase in cost.—L.M.F.

A. It is not safe and never was safe to put an actual continuous load of 400 amperes on a 500,000 C.M. rubber covered wire where there are three or more in a conduct.

Fortunately our wires were seldom



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loaded to the full table ratings as given in the wire tables prior to the 1940 Code. Where they were, trouble was often experienced. Loads were then generally computed on total connected loads and such loads were not kept on full tilt continually. Hence the demand generally could safely be carried by the wire.

The carrying capacities given in the tables in the 1940 and 1947 Codes are based on engineering data and are safe and any greater are not safe for continuous loads.

The Supplement to the 1940 Code, in Interim Amendment No. 41, permitted the use of the 1937 table values for non-continuous loads, but still required the lower capacities for continuous loads.

In reference to the point in question the wire referred to was installed in 1937 and had the then Type R insulation which was not the same as the present Type R insulation. The present Type R insulation is approximately the grade of the old (1940) Type R P. Therefore if the continuous load is over 265 amp. (see 1940 Code for Type R capacity) a larger feeder should be installed.

However, if the continuous load will not exceed 265 amps. and if fuses of not over 275 amps. can be maintained even though the total connected load is 400 amps., the present feeder might still be used.

It should be kept in mind that the 320 amp. capacity given in the 1947 Code for Type R, is for the new Type R which compares with the old Type R P.

We have referred to "continuous loads" several times above, so here is the definition of that term: "Operation where the conductors are loaded to the maximum capacity (of the amperes given) for a period exceeding three consecutive hours or six non-consecutive hours during any 24 hour period."

As a suggestion, it might be possible to pull out the old conductors and pull in new Type R H conductors, thereby obtaining a carrying capacity of 380 amperes if, as stated in Table 11 "it is impracticable to increase the size of raceway due to structural condition."—F.N.M.S.

Rewiring Buildings

Q. *As I understand the Code, even on a rewiring job a person cannot pull more conductors in conduits which are not embedded within the building structure or finish than are permitted in new work. With the new building wires smaller in over-all diameter, it seems a waste of metal to*

make such drastic restrictions on the number of wires permitted within the conduit. This is especially true in the newer industrial plants where steel deck roof structure means that practically all conduits are run in the open. Have I missed some exception which would permit greater conduit fill especially on the shorter runs?—K.N.

A. There are no exceptions as yet, except for control conductors. This question will undoubtedly be up for discussion at the next meeting of the National Electrical Code Committee as a good many contractors are unconvinced of the value of the present ruling. Many feel that conduits smaller than ½ inch could be used to advantage.—G.R.

Insulators

Q. *We plan to wire an all metal building that will be used as a stone worker. This building is a rather long structure, so we plan to locate the service at the center and extend feeders both ways. To obtain maximum capacity for the feeders, we wish to use open wiring and would like to support them from steel beams located on twelve foot centers that support the roof structure. The local inspector is asking for 4½ foot spacing of supports but that seems rather unnecessary for 500,000 C.M. conductors. We cannot find any permission in the Code for greater spacing but feel sure there must be some provision that we cannot find. We understand that by using wire racks and six inch spacing twelve foot supports would be O.K., but we wish to use insulators that space the conductors equidistant from each other to reduce reactance. Can you supply the section containing the exception to this 4½ foot rule?*—R.G.E.

A. Section 3204 of the 1947 edition of the N. E. Code provides the exception you are looking for. This exception is as follows: "If circuits of No. 8 or larger are run across open spaces where not liable to be disturbed, they may be supported at distances not greater than 15 feet if approved noncombustible, nonabsorptive insulating separators providing not less than 2½ inch separation between conductors are installed at intervals of not over 4½ feet." This exception was not contained in the previous code. However, several concerns have manufactured insulators and spacers of this type for some time. —G.R.

In the News

IES Conference Held in Washington

The industry-wide *Planned Lighting* program, and various technical papers on a wide range of lighting subjects, formed the basis for a crowded two-day conference held by the East Central Region, Illuminating Engineering Society on May 15-16 in Washington, D. C. Approximately 160 members and guests were registered for this meeting, sponsored by the Pittsburgh, Philadelphia, Baltimore and Capital (Washington) Sections of the Society.

Regional Vice President Arthur A. Brainerd, Philadelphia Electric Company, opened the two-day conference in a brief talk in which he outlined the aims and objectives of the conference. Gilbert S. Underwood, Supervising Architect for the Public Buildings Administration, Federal Works Agency, then presented a paper on the lighting of public buildings, especially Federally-owned buildings. He stressed the importance of close cooperation between illuminating engineers, color specialists and architects. He said that the architect should be "the guiding spirit" in planning any public building, and in coordinating illumination, engineering and the work of the decorator.

Joseph S. Schuchert, commercial sales manager for Duquesne Light Company, Pittsburgh, told the conference about the *Planned Lighting* program being sponsored by the Edison Electric Institute, and to be participated in by all segments of the lighting industry. He related the history of the program to date, and outlined its objectives, its present status, and what it will mean to the lighting industry if all branches of the industry give it full support. Conceived more than a year ago, the program is planned "to provide customers with modern lighting installations designed to serve economically and efficiently their specific living, working and selling needs," he stated. Several companies are already using the basic idea, he said, and because the plan is flexible and has merit, it can be adopted by manufacturers, distributors, electrical contractors and utilities on both a local and a national level. National groups have already promised to support the program through promotional and advertising effort. The national promotional program includes an outline of markets, types of organization and suggested sales and promotional methods for each of the five major lighting markets—homes, stores, factories, schools and offices, it was pointed out.

Walter Sturrock, General Electric Company, Nela Park, briefly summarized a paper on "Light for Comfortable Seeing," prepared by Ward Harrison, General Electric Company, who was unable to attend the conference. This paper outlined the need for glare evaluation, and proposed an empirical formula for determining glare factor values. Glare factor tables for several types of luminaries, in various size rooms, and for several reflectance values of ceilings and side walls were presented with the paper, and their possible value in determining comfortable seeing discussed.

Harris Reinhardt, Sylvania Electric Products, Inc., discussed at length the efficiency characteristics of modern light sources, and illustrated his discussion with a number of lantern slide charts, tables, and graphs. Included in his presentation was a comparison of the efficiency of ideal and actual light sources, lamp efficiency and overall efficiency, need for maintenance, and possible future improvements in light source efficiencies.

A most interesting highlight of the conference was a demonstration of war-developed infra-red radiation applications used by the Army, which was given by Oscar P. Cleaver, The Engineer Board, Fort Belvoir, Va. The demonstration included the "sniper-scope" rifles, and "snooper-scopes" through which an infra-red movie, projected on a screen concurrently with visible slides, could be viewed. Newly developed filters were discussed, as well as various types of reflectors and reflecting materials for infra-red radiation. Much progress was made by the Armed Services in the study and application of infra-red during the war, Mr. Cleaver stated, and this was impressively evident from the data shown by slides covering information now being released to the public for the first time.

A "Travelog of Lighting in the East Central Region" was presented by C. C. Shotwell, Philadelphia Electric Company. This included a slide round-up of outstanding and interesting lighting installations made throughout the area, with a brief summary description of the lighting techniques and results on each job.

In a talk on "Street and Highway Safety Lighting," Warren H. Edman, manager of the Lighting Division, Line Material Company, summarized the objectives of President Truman's Highway Safety Conference in the spring of 1946 and what has been accomplished since. Statistics show the traffic fatality curve to be climbing, it was reported, and unless better engineering, including modern lighting is

"They're from the Humane Society, boss. We'll have to stop usin' moles to pull our conduits underground."

Joe S. Schuchert, Duquesne Light Company, Pittsburgh, presented the EEI-sponsored Planned Lighting program to members and guests of the Illuminating Engineering Society's East Central Regional Conference, held in Washington, D. C. in May.

incorporated in roads, the 1941 peak (all-time high) will soon be exceeded. Mr. Edman discussed ways to put the IES "Recommended Practice of Street and Highway Lighting" to work, this recommendation being recognized as the best known guide and authoritative publication available on this subject.

Jack L. Kilpatrick, Silvray Lighting, Inc., gave a stimulating discussion on "What's Wrong with Street and Highway Lighting?", and urged greater study of the problem of lighting for streets and highways, as well as greater use of the IES "Recommended Practice" and any other data available on the subject when planning highway lighting installations.

Stewart R. Williams, the Holophane Company, Inc., summarized new developments in street and highway lighting up to the present. The lighting tools are available, and it is up to the lighting specialists to point the way to their proper application in lighting America's streets and highways and thus help to reduce traffic fatalities on these highways, he said.

Lillian E. Eddy, Home Lighting Specialist for the General Electric Company, gave a very comprehensive report covering "Highlights in Residential Lighting." "We can wholeheartedly say there is much new in residential lighting," she stated. "Fixture designers and manufacturers are rapidly turning out "packaged" equipment, that, in the hands of those unfamiliar with lighting design and in the hands of the mechanic who does the installing, can turn out good lighting results," she said.

Lighting standards for the home, trends in fixture design, and trends in

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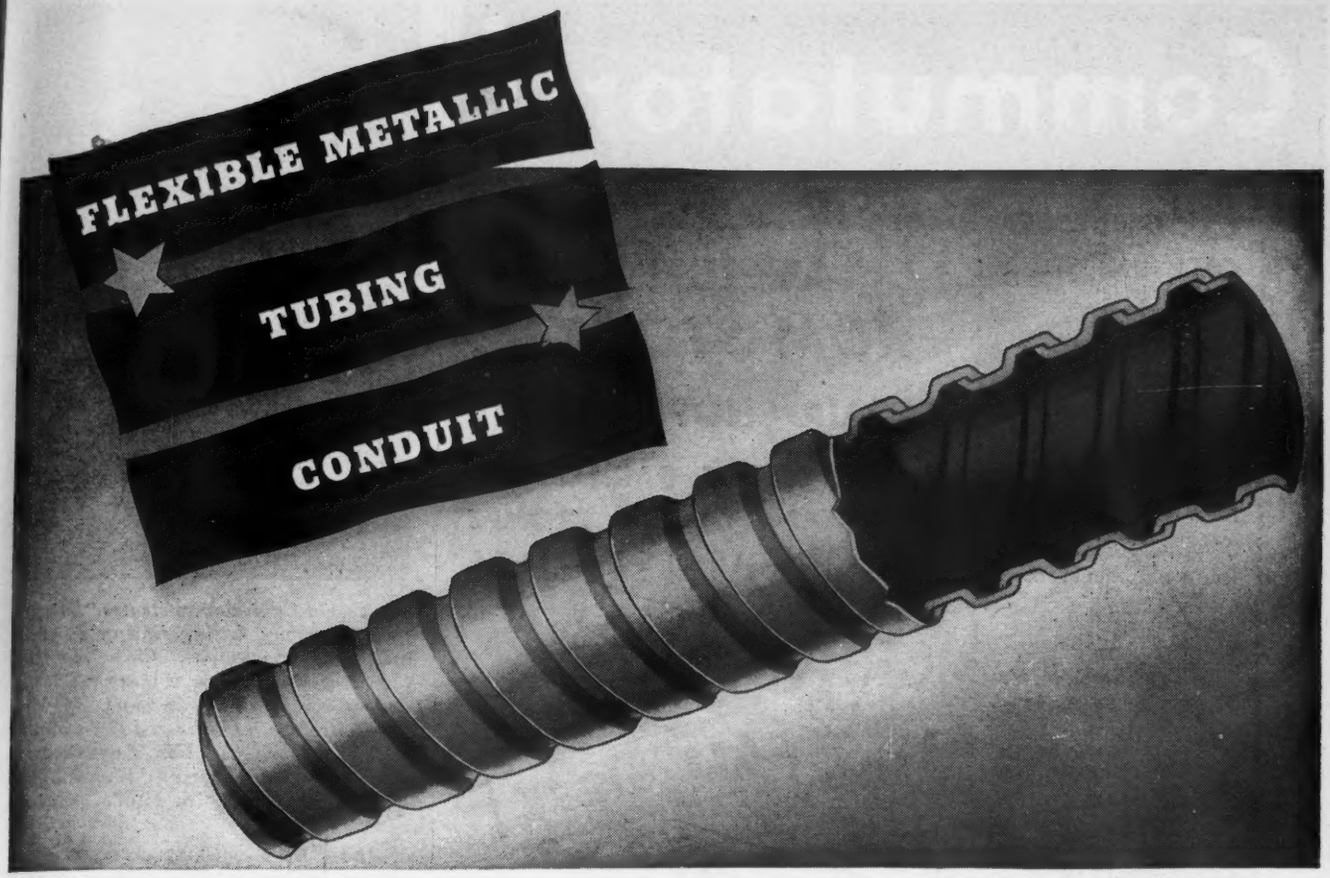
Taking active part in first day's session of the East Central Regional Conference, IES, Washington, D. C. on May 15-16, were: Oscar P. Cleaver, The Engineer Board, Fort Belvoir, Va.; Harris Reinhardt, Sylvania Electric Products, Inc., Ipswich, Mass.; C. C. Shotwell, Philadelphia Electric Co., Philadelphia, Pa.; and Leo P. Moran, Westinghouse Electric Corp., Philadelphia, Pa.

architectural lighting were discussed in detail. Architectural lighting trends covered included valance lighting, cove lighting, soffit lights and recessed panel lighting, bay window and niche lighting, bookcase and cupboard lighting, mantle lighting, down lights and furniture lighting. Types of equipment for each application and proper methods for locating and installing were outlined in each case. Summing up, Miss Eddy cautioned "a finely planned modern residential lighting system requires the coordinated work of the architect, the decorator and the lighting specialist. The perfect modern home lighting job begins on the architect's drafting board and is only finished when the last piece of furniture has been moved into the house and the last portable lamp put in place."

Myrtle Fahsbender, Director of Residential Lighting for the Westinghouse Lamp Division, told the conference there are two certification programs in the field of home lighting—a certified lamp (portable) program and a certified fixture program. In a paper on "What's Ahead in Certified Home Lighting Equipment," Miss Fahsbender described the two certification programs and outlined the individual specifications for the various types of lamps. "Over one hundred portable lamp manufacturers are now members



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1219

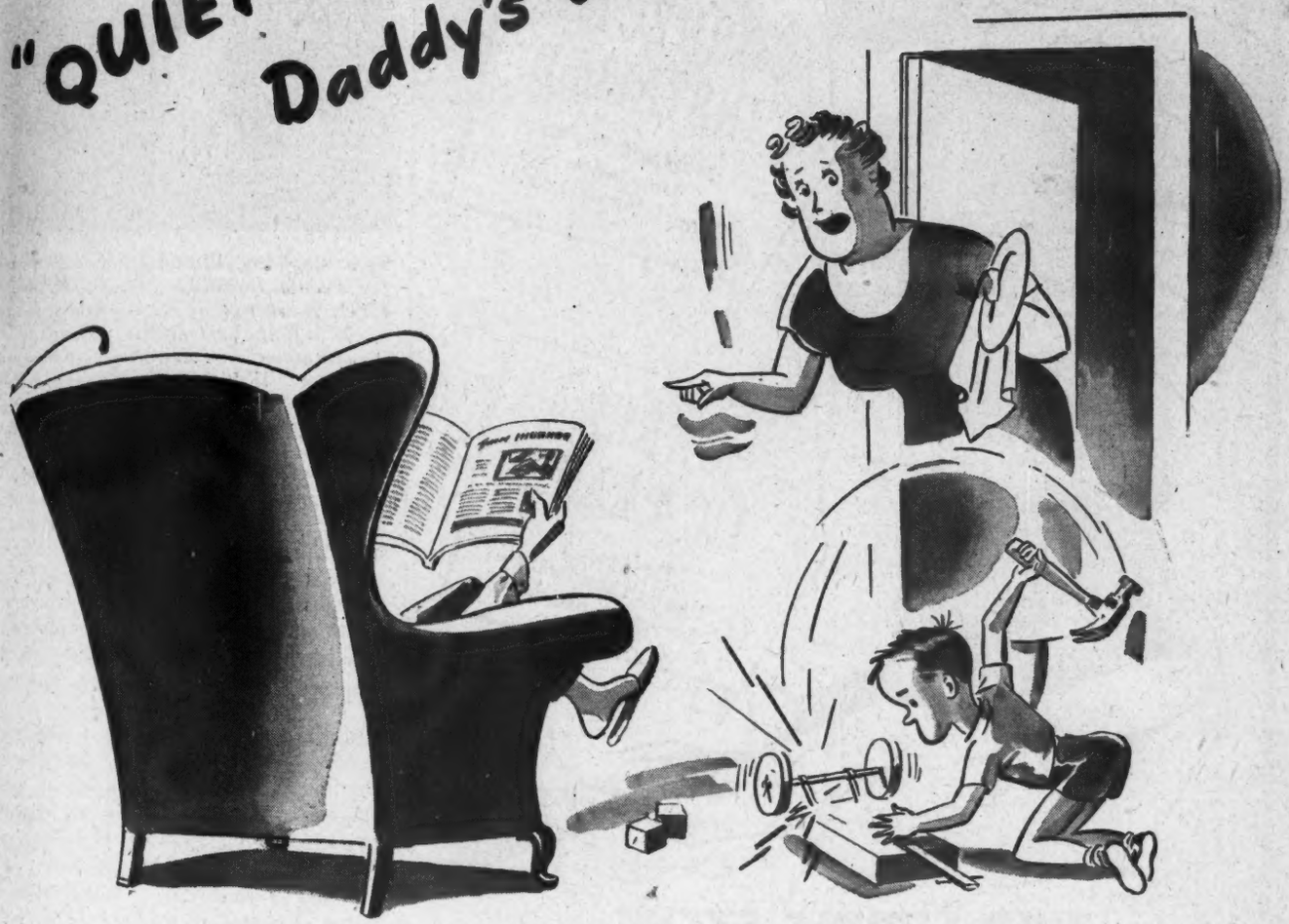
Sgt. David Cohn demonstrates "Sniperscope", army rifle equipped with infra-red attachment, for Oscar P. Cleaver, both of The Engineer Board, Fort Belvoir, Va., as part of Mr. Cleaver's talk on infra-red light applications before the IES East Central Regional Conference, Washington, D. C., on May 15-16, 1947.

of the Certified Lamp Makers," she said and "Seventeen leading residential lighting fixture manufacturers (membership of the American Home Lighting Institute) are determined to raise their sights to a level never before attempted or achieved." Lantern slides giving technical data and sample floor and table lamps were used.

The "Economics and Maintenance of Industrial Lighting Systems" was presented by Walter Sturrock, General Electric Company, Nela Park. This paper included a cost analysis of eight industrial lighting systems designed to provide 50 footcandles in an 8,000 sq. ft. area. Four of the systems used standard fluorescent lamp sources, two used mercury vapor, one used combination mercury vapor and incandescent, and one used incandescent. Both single-shift and two-shift operations were covered by the report. The straight mercury lighting systems were the least expensive, both initially and on an over-all basis, according to the study, with combination mercury-incandescent lower in cost than either the incandescent alone or any of the fluorescent systems. Supplementing the cost analysis study was a table indicating "Months Between Cleaning of Luminaires for Optimum Economy," using variables for cost per luminaire for owning, cleaning and depreciation between cleaning due to dirt or dust accumulation.

"The term *candles* and *brightness* are not as useful as they formerly were," said George Ainsworth, New

"QUIET JUNIOR! Daddy's doing his homework"



Junior's old gent is a busy man.

He has to have plenty of "know-how" to keep on top of his job.

Sometimes it takes home-work to keep abreast of things and right now he's reading this issue of this McGraw-Hill magazine—the one you are holding in your hand.

Obviously, he's not looking for glamour, amusement, or entertainment. *He is strictly on the make for ideas.*

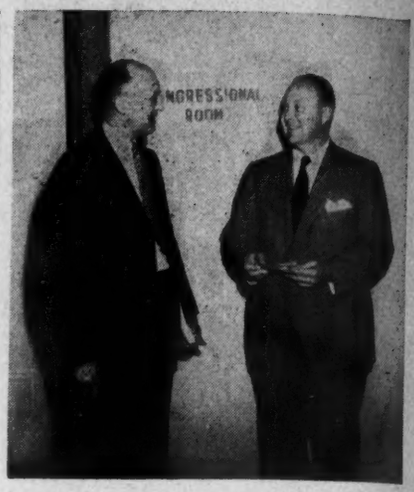
He wants to know what the other fellow is doing—what's new in methods and processes that will help him do a better job.

He's an avid reader of the ad-pages as well as the editorial content. The advertisements along industry's shopping street give him an opportunity to inspect the products and services of America's leading manufacturers—and he examines them with an eye to what they can do for him.

Yes—Junior's old gent is a busy man. But he never misses a trick!

To keep in touch with the parade • • • read the ads.

F-4



Tom Coghlan, illuminating engineer for Public Buildings Administration, FWA, Washington, D. C., chats with F. W. Wakefield Brass Company's Washington representative, Charley "Senator" Robison, during the conference of the East Central Region, IES, in Washington on May 15-16, 1947.

York City, in discussing "The Changing Center of Interest in Illumination." Mr. Ainsworth said, "As we approach the better kind of lighting, we require a technique that *directly* appraises visual conditions. Footcandlism is an *indirect* method of appraisal that evolved from the primitive candle and lamp sources of light."

Willard Allphin, Sylvania Electric Products, Inc., discussed "Brightness Engineering Applied to School and Office Lighting," and presented brightness data from existing installations.

Samuel G. Hibben, Director of Lighting Research, Westinghouse Lamp Division, Bloomfield, N. J., was guest speaker at the dinner banquet, held at the end of the first day's session. Mr. Hibben gave the interesting history of lighting in the White House and illustrated his talk with a wide variety of lantern slides. His presentation included the lighting in many rooms and areas of the White House not usually seen by the public.

A color film by DuPont on "Color Conditioning" was shown.

A "Planned Lighting Sales Forum," participated in by representatives from electric utilities, electrical wholesalers, lighting equipment manufacturers, electrical dealers and electrical contractors ended the two-day conference.

Chairmen for the four morning and afternoon sessions were: Leo H. Cleary, Chairman, Capital Section; Leo Moran, Chairman, Philadelphia Section; Lucien Kight, Chairman, Pittsburgh Section, and P. M. Wood, Chairman, Baltimore Chapter. Albert A. Fox, Office of Housing Expediter, Washington, D. C., was chairman of the General Conference Committee.

New Law Bans Closed Shop, Boycotts

The Taft-Hartley labor bill became the law of the land on June 23 when the Senate overrode a Truman veto, 68-25, after a 331-83 vote by the House. But the full impact of this first peacetime change in federal labor policy since the Wagner Act was passed in 1935 won't be known for at least a year. Until July 1, 1948, various parts of the law will take effect at different times.

Government injunctive procedure for coping with "national emergencies" such as a coal strike and, conceivably, a power shutdown over a large area became effective immediately. Also stopped immediately is the making of a contract calling for (1) the automatic checkoff of union dues or (2) employer contributions to a union-controlled welfare fund. Suits may now be filed for damages resulting from contract violations, jurisdictional disputes or secondary boycotts.

Not effective until August 22 are the broad functions of the enlarged NLRB. This includes bringing of unfair labor practices against unions; the 60-day notice of contract changes or termination; the filing of financial statements by unions and non-communist affidavits by union officials; the closed shop ban; denial of bargaining privileges to supervisors; and the various new NLRB elections.

Closed shop agreements signed between June 23 and August 22 cannot run for more than a year. Others previously in effect cannot be renewed when the existing agreement expires.

Existing welfare funds which went into effect after January 1, 1946, must conform to the new limitations when the agreement expires, but not later than July 1, 1948.

Technically, NLRB will still function under the Wagner Act until August 22, but it's inconceivable that it would press for enforcement of any existing or new decisions which conflict with the Taft-Hartley provisions.

New NISA Chapters

Four new chapters have been added to the rapidly growing roster of the National Industrial Service Association. A Midwestern Chapter was organized May 9th in Omaha, Nebraska; an Indiana Chapter on May 15 in Indianapolis and an organizational session was held in Philadelphia. Members in the Cleveland area met June 21 to form the fourth new group.

Officers of the Midwestern Chapter

are: Chairman—M. F. Zack, Zack Brothers Electric Co., Mason City, Iowa; vice-chairman—W. H. Guthrie, Omaha Electric Works, Omaha, Nebraska; secretary-treasurer—C. J. Miller, H. W. Miller Electric Co., Omaha.

The official family of the Indiana Chapter includes: Chairman—R. A. Scherer, Scherer Electric Co., Indianapolis; vice-chairman—E. E. Fuhrman, Wayne Electric Co., Fort Wayne; secretary—F. L. Meier, Meier Electric & Machine Co., Indianapolis; treasurer—C. W. Nunn, Swanson-Nunn Electric, Evansville.

New York State Contractors Meet

Interdependence of all branches of the electrical industry was the keynote of the 48th annual convention, attended by 250 electrical contractors and guests, of the New York State Association of Electrical Contractors & Dealers, Inc., held at Saranac Inn, New York June 10-15.

Greater cooperation among the various branches of the electrical industry was the theme of the opening address by Ray W. Mitchell, Wipperman & Mitchell, Inc., Buffalo, and president of the Association. A. Lincoln Bush, chairman of the board of the Association and president of Belmont Electric Co., New York, presided.

The wholesalers, manufacturers and utilities viewpoints of interdependence were expressed by H. C. Calahan, commercial vice president, General Electric Supply Corp., New York; N. J. MacDonald, vice president, Thomas & Betts Co., Inc., Elizabeth, N. J.; and E. A. Brand, district commercial manager, Buffalo Niagara Electric Corp., Buffalo, respectively.

Harris E. Dexter, vice president, Central Hudson Gas & Electric Corp., Poughkeepsie, outlined the Electrical Living Program developed by EEI. He showed the symbol that has been adopted to promote the electrical living theme and urged all contractors to use it on their letterheads, trucks and in their advertising. He also said that EEI has prepared a 32-page booklet featuring everything that goes into the modern home in the way of electrical equipment, which will be ready for distribution shortly.

At the evening meeting Frank E. Watts, executive assistant of *Farm Journal* gave facts and figures on the tremendous farm market and pointed out the many opportunities for electrical contractors in New York State. He concluded his talk by showing the motion picture "Singing Wires".

How the contractors could get their share of the planned lighting market was discussed by J. T. Coatsworth, commercial director, Edison Electric Institute, New York, at the Thursday morning session, presided over by Ray W. Mitchell. "Interdependence—The Part of the Chain Distributor" was presented by Roy L. Brown, district manager, Westinghouse Electric Corp., New York, and the contractors viewpoint of interdependence was discussed by A. Lincoln Bush, vice president, National Electrical Contractors Association and chairman, Joint Industry Board of the Electrical Industry of New York.

The adequate wiring story was told by P. E. McCaughey, manager, National Adequate Wiring Bureau, New York. He urged the contractors to set up local adequate wiring bureaus in their cities and showed the step by step procedure involved.

Mr. Bush presided at the Friday morning session. The viewpoint of the independent wholesaler was discussed by E. A. Jones, president, Havens Electric Co., Albany.

Louis Freund, chairman, Vocational and Apprenticeship Committee, Joint Industry Board of the Electrical Industry of New York, discussed time saving tools and methods, and told of the plan adopted in New York City to encourage employees to submit ideas for shorter and improved methods of doing work.

"The Heat Pump and Its Possibilities—Electric House Heating" was presented by W. A. Turnbull, power engineer, New York State Electric & Gas Corp., Binghamton. The changes in the 1947 Electrical Code were discussed by J. D. Lynett, superintendent, Bureau of Electricity, New York Board of Fire Underwriters. J. D. Drohan, eastern district sales manager, Wire and Cable Division, and H. Cluver, eastern district engineer, U. S. Rubber Company, New York, talked on "Aluminum as a Conductor of Electricity."

5-Day Week For Chicago Builders

Effective June 2nd, building construction in Chicago went on a compulsory, rigid, five-day week. The move was made to cut construction costs and spur new building, according to H. Mayme Stanton, executive secretary of the Building Construction Employers Association. By eliminating Saturday work, which carries a double-time rate, labor costs can be reduced about 16⅔ percent, Stanton re-

vealed. Although workers like to work the sixth day because of the pay increase, union leaders have decided that keeping building construction at a high level is of more benefit to their members.

Both builders and union leaders are of the opinion that a high construction volume can be obtained only if costs are reduced according to Stanton and Earl J. McMahon, secretary-treasurer of the Chicago Building and Construction Trades Council (A.F. of L.). Many large building projects, previously deferred because of costs, are now expected to be started.

Insofar as electrical contractors are concerned, this new ruling will have little effect. Approximately 80 percent of the electrical work in the Chicago area is in existing buildings where change-over and cut-overs must be made on Saturday or Sunday when the plants are not in operation. Where new construction is concerned, however, the electrical contractors and union will adhere to the five-day week.

Volheye Heads IAEI

New president of the International Association of Electrical Inspectors is W. R. Volheye of Portland, Oregon. At present he is chief electrical and safety inspector, Bureau of Labor, State of Oregon.

With the exception of one year, Mr. Volheye has been actively engaged in the electrical industry since 1906 when he began his apprenticeship with the Claggett Electric Company of Oregon. Much of his experience was in the electrical construction field where he served as journeyman electrician, shop and job foreman and superintendent for various companies. In 1934 he was supervisor in charge of rewiring 83 schools in the Portland district.

On June 1, 1935, Mr. Volheye was employed by the State of Oregon as an electrical inspector and was made chief inspector nine months later. He served as director of apprenticeship for the State of Oregon in 1944 and part of 1945. The new IAEI president joined the Northwestern section as a member in 1935, served as its president in 1942-43, was first vice-president of the international association last year.

Other international officers elected to serve with Mr. Volheye are: first vice-president—J. G. Fisher, Jackson, Miss.; second vice-president—Charles A. Ward, Paterson, N. J.; third vice-president—John E. Wise, Madison, Wis.; fourth vice-president—Arthur C. Veit, Los Angeles, California. Victor H. Tousley, Chicago, was re-elected secretary-treasurer.

Construction For 1947

Building has flattened out much sooner than expected. New expenditures for construction this year will total about $12 billion, instead of the $15 billion which had been expected last winter, according to Ewan Clague, Commissioner of Labor Statistics.

Although 1947 will be one of the best construction years in history, both housing and non-residential construction are lagging, by at least one-fourth behind previous expectations.

The number of permanent dwellings placed under construction this year is now expected to exceed last year's performance by only about 55,000.

"Building costs, higher than had been expected, were the most important single factor in putting a brake on the construction pace," reports Commissioner Clague. "The cost spiral, according to present indications, has now spent itself, and prices should tend moderately downward. A continued record-breaking volume of housing is still urgently needed in this country. The demand is mostly for more lower-cost and rental housing than we have been getting in the past year."

Construction gained in May, but only seasonally. Total dollar volume rose 10 percent over April to $1.1 billion, according to preliminary BLS estimates. Gains over the month were larger than usual in highway and public utility construction, but less in private residential building. In the non-residential field, commercial building showed a slight upturn for the first time since it began to fall off almost a year ago, but industrial construction continued the downtrend which began last fall.

The spring rise in housing starts levelled off in May. Permanent dwellings placed under construction totalled 69,000 units, virtually the same as in April, according to preliminary BLS estimates based on the revised series now being issued. It appears likely that April and May will prove to be the peak months for housing starts this year, as they were last year. Completions of permanent dwellings were estimated at about 60,000 in May, or about 2,000 more than in March.

Wiring Devices

The upward production trend of four out of five critical electrical wiring devices shows a general levelling off during April, May and June, according to manufacturers' monthly re-

ports to the Office of the Housing Expediter.

Production of connectors continues its rapid advance. Convenience receptacle production in April showed no increases, while toggle switch, lamp holder and box production rose slightly over March. May and June production increases are anticipated for connectors, toggle switches and convenience receptacles, but decreases are expected for lampholders and outlet, switch and receptacle boxes.

Output of all items except lampholders is still short of national requirements. With regard to lampholders, however, certain types, such as pull chain and keyless porcelain, continue to be scarce.

Shortages of raw materials continue to be the prime factor restricting production of electrical wiring devices. Specifically mentioned by manufacturers were shortages of steel, phenolic resin molding compounds and components such as screws.

Actual and estimated production of the critical electrical wiring devices, April through June, tabulated from manufacturers' monthly reports, is shown below:

Devices*	April (Actual)	May (Estimated)	June (Scheduled)
	(in millions of units)		
Toggle Switches	5.4	6.0	6.6
Convenience Outlets (Receptacles)	5.7	6.3	6.9
Sockets (Lampholders, Lamp Receptacles Medium Screw Base)	14.5	16.7	16.6
Outlet, Switch and Receptacle Boxes	11.1	11.2	11.1
Box Connectors for Metallic Sheathed ("BX") and Non-metallic-sheathed ("Romex") cable	13.2	13.8	14.0

*Suitable for residential use.

Attending the Foremen's meeting of the New England Chapter of NISA in Boston recently were (L. to R.): Ernest Bogusch, Joseph Calhoun, Henry Nolte and Paul Leicht, all of Empire Electrical Co., Cambridge, Mass.

Homeward bound after attending Foremen's Meeting sponsored by New England Chapter, NISA, in Boston, are (L. to R.): Arthur Feiley, Walco Products, Providence, R. I.; Maurice Hickey and Oliver Parker, Shepard and Parker Co., Fitchburg, Mass.

Railway Signal Equipment

Manufacturers of railway signal equipment saw a half billion dollars worth of business coming their way when the Interstate Commerce Commission recently ordered railroads to expand signal systems on trackage carrying high speed traffic.

All Class I, switching and terminal railroads are required by the order to install on lines over which any passenger train is operated at a speed of 60 or more miles per hour, or any freight at a speed of 50 or more mph, an automatic block signal system which will conform to the rules, standards and instructions outlined by the commission in a 1939 order.

Six representative railroads submitted cost figures for installation of the various types of equipment. Averaged out, the estimates for automatic block signals approximated $6,000 per mile of track for single and $4,000 per mile of track for multiple track.

Installation costs for automatic block signals with intermittent inductive train control ranged from $400 to $700 per mile in addition to the cost of the automatic block system, plus $2,000 to $2,300 per locomotive.

Block systems with continuous cab signals were estimated to cost $5,000 per mile (single track), and $4,000 per mile (multiple track) plus cost of block system plus $2,260 per locomotive.

Block systems with continuous automatic speed control (multiple track) were estimated at $3,000 per mile, plus the costs of the block and $5,000 per locomotive.

Power Factor

W. C. King, sales engineer and author of "Power Factor in Your Plant," has turned out a technical handbook that is not only easy to read but readily understood. The book, written for practical maintenance engineers, is presented in an easy and conversational, yet factual and hard-hitting manner. Commonly-asked, down-to-earth questions take the place of formal chapter headings, and the answers, in the words of one chief electrician, "are in plain English and skip the fancy mathematics." Typical questions discussed include: "How do I determine the Power Factor in my plant?" "What effect does Power Factor have on Voltage Drop?" "For what types of drives are Synchronous Motors?", "Does it cost more to run a Synchronous Motor than an Induction?", "Will it be cheaper to improve my Power Factor or put in another feeder?" and "What's inside one of these Capacitor Units?"

In addition to supplemental charts, tables, graphs, diagrams and photographs, a list of recommended magazine articles on related subjects is included for the reader's information. The book, measuring 6-by-9 inches, contains 208 pages and sells for $3. Published by Cornell-Dubilier Corporation, South Plainfield, New Jersey.

DATES AHEAD

First Annual Store Modernization Show—Grand Central Palace, New York, N. Y., July 7-12.

Illuminating Engineering Society—Annual convention, New Orleans, La., September 5-10.

National Electrical Contractors Association—Annual meeting, Palace Hotel, San Francisco, Calif., September 8-10.

Illuminating Engineering Society—Technical Conference, Roosevelt Hotel, New Orleans, La., September 15-19.

International Association of Electrical Inspectors—Northwestern Section, Eugene Hotel, Eugene, Ore., Sept. 22-24; Southwestern Section, Mission Inn, Riverside, Calif., September 29-October 1; Western Section, Mount Royal Hotel, Montreal, Quebec, Canada, October 13-15; Eastern Section, Seaside Hotel, Atlantic City, N. J., October 20-22; Southern Section, Hotel George Washington, Jacksonville, Fla., October 27-29.

International Municipal Signal Association, Inc.—Annual meeting, Pantlind Hotel, Grand Rapids, Mich., September 29-October 2.

National Safety Congress & Exposition—Chicago, Ill., October 6-10.

First Annual Cold Cathode Fluorescent Lighting Exhibit—Hotel Commodore, New York, N. Y., October 7-9.

National Farm Electrification Conference—Claypool Hotel, Indianapolis, Ind., October 7-8.

National Electrical Manufacturers Association—Traymore Hotel, Atlantic City, N. J., Week of Oct. 26.

American Institute of Electrical Engineers—Midwest meeting, Chicago, Ill., November 3-7.

2nd International Lighting Exposition—Hotel Stevens, Chicago, Ill., November 3-7.

National Metal Trades Association—Palmer House, Chicago, Ill., November 6-17.

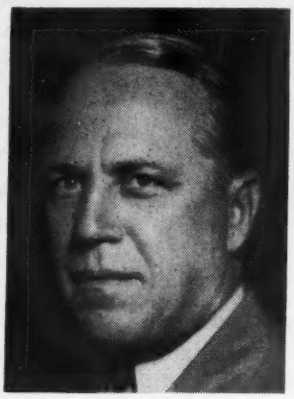
National Association of Manufacturers—Waldorf-Astoria Hotel, New York, N. Y., December 3-5.

MANUFACTURERS NEWS

H. V. ENGH ELECTED PRESIDENT OF PYLE NATIONAL COMPANY

Harold V. Engh, executive vice president of Anaconda Wire & Cable Company, New York, has been elected president and general manager of the Pyle-National Company.

Mr. Engh is a native of Chicago and started his business career with Chicago Insulated Wire & Mfg. Company. He enlisted in the U. S. Air Service and served both here and abroad as a pilot



H. V. ENGH

officer during the first World War. In 1928 he became president of Inland Cable Company. When Inland consolidated with Anaconda in 1929, Mr. Engh joined Anaconda as vice president.

Other officers of Pyle-National elected with Mr. Engh are A. N. Martin, vice president; John L. Vogel, secretary-treasurer; and Ella M. Franklin, assistant secretary-treasurer.

Donald S. Boynton, John W. Leslie, Ernest Waud, L. A. Vilas and Harold V. Engh were elected directors.

WESTON ELECTRICAL OFFICERS ELECTED

The Weston Electrical Instrument Corporation of Newark, N. J. has announced the election of the following officers: Edward F. Weston, chairman of the board; Caxton Brown, chairman of the executive committee; Earl R. Mellen, president; H. Leigh Gerstenberger, vice president in charge of sales; Reginald R. Lambe, vice president in charge of manufacturing; John H. Miller, vice president and chief engineer; Ross Nichols, secretary and treasurer; and F. G. Hawthorne, comptroller and assistant secretary.

Mr. Mellen joined the organization in 1917, was made treasurer in 1928, and

E. R. Mellen

since 1944 has been executive vice president and treasurer.

The meeting of the board of directors followed the annual meeting of stockholders, at which Mr. Weston, Mr. Brown and Mr. Mellen, together with Willis H. Booth, Horace K. Corbin, Richard W. Seabury and Waldron M. Ward were re-elected directors.

J. H. JEWELL NAMED MANAGER WESTINGHOUSE APPARATUS SALES

J. H. Jewell has been appointed manager of apparatus sales of the Westinghouse Electric Corporation, with headquarters in Pittsburgh.

A veteran of 27 years with Westinghouse, Mr. Jewell has been manager of

J. H. Jewell

the company's industry sales departments since 1944. He has been serving recently as acting manager of apparatus sales.

SYLVANIA APPOINTMENTS

Charles A. Burton has been appointed assistant general sales manager of the Lighting Division of Sylvania Electric Products Inc.

George W. Field and Ralph E. Niedringhaus have been named manager of the Central and East Central Divisions of Sylvania's sales forces, respectively.

Terry P. Cunningham has been appointed advertising manager of the Radio Tube Electronics and International Divisions of Sylvania.

G-E APPOINTMENTS

F. M. Falge, sales executive for General Electric Lamp Department at Nela Park, has been promoted to the position of assistant manager of the department's Pacific Sales District, San Francisco.

T. A. Worcester, assistant manager of G-E's central station division, has retired after 42 years of service with the company, and S. B. Crary and W. J. McLachlan have been appointed assistant managers.

•

Arthur S. Tylor, former manager of the Lighting Sales Department of **Corning Glass Works,** has been appointed general sales manager of the company's Technical Products Division.

Named to Mr. Tyler's former lighting sales post is William J. Belknap, who was formerly manager of the market research department.

•

Albert T. Bergeron, sales manager of the Illuminating Division of **The Miller Company,** Meriden, Conn., has been appointed to the post of manager of this division. He will continue to direct lighting sales.

•

Edward Maged, formerly sales engineer with the David Bogen Co., Inc. of New York has joined **University Loudspeakers, Inc.** He will make his headquarters in the general offices at 225 Varick Street, New York.

•

The Champion Lamp Works of Lynn, Mass., has appointed John W. Romig as assistant general manager covering sales, engineering and manufacturing activities. Prior to joining Champion Lamp, he was sales manager of the Technical Products Division of Corning Glass Works.

•

Frederick C. Stakel, former Lieutenant Commander, U.S.N.R., has joined **Brown Company** as manager of advertising and sales promotion. He is now located at the New York office, 500 Fifth Avenue.

•

All plants of **Sola Electric Company** are now housed in their own building located at 4633 West 16th Street, Chicago, Ill.

•

The Stanley & Patterson Division of **Faraday Electric Corporation** has moved its Boston plant to Adrian, Michigan.

•

Garden City Plating & Manufacturing Company has moved into a new plant at 1750 North Ashland Avenue, Chicago. They were formerly located at 1430 South Talman Avenue.

AWARDS FOR LIGHTING

[FROM PAGE 73]

Minimum Data Required for Judging Merit Awards:

1. Your name and address attached or clipped to first page.
2. Registration number (also at top of each page and exhibit of entry) and name of your firm.
3. Type of installation (industrial, commercial, street lighting, floodlighting, school lighting, etc.).
4. Name and address of customer or client for whom the work was done.
5. Date installation was completed.
6. 8x10 in. installation photograph and layout (for relighting jobs, a before-and-after photograph is most acceptable but not mandatory). Interiors should be described and complete dimensions given.
7. Type, catalogue number and manufacturer's name of fixtures used in installation.
8. Illumination and brightness measurements in terms of footcandles, footlamberts, etc. A description of the method and procedure, instruments used, locations and plans, age of installation, etc., should accompany data.

Additional data which may be included to earn Merit Awards.

INDUSTRIAL INSTALLATIONS: Reports may describe benefits realized from planned lighting for a stated period of time, such as:

Increased production (percentage or quantity)

Lower costs (percentage or dollars)

Better workmanship (statement, preferably by customer)

Fewer rejects (percentage or quantity)

Better working conditions (statements, preferably by customer or his workers)

Fewer accidents (percentage or number)

Better employee morale (statement, preferably by customer)

Other changes made, such as painting, structural changes, etc.

COMMERCIAL INSTALLATIONS: Reports may give information along following lines for a stated period of time:

In case of Stores—

Increase in floor traffic (percentage or statement, preferably by customer)

Increase in sales (percentage)

Fewer returns or complaints (statement, preferably by customer)

Sales of higher quality merchandise (from spotlighting)

Better utilization of selling space

Less absenteeism

Other changes made, such as painting, structural changes, etc.

In case of Offices—

More work done (percentage or amount)

More accurate work (statement, preferably by customer)

Better morale, fewer employee complaints (statement, preferably by customer)

Less absenteeism (statement, preferably by customer)

Other changes made, such as painting, structural changes, etc.

REPORT OF STREET LIGHTING INSTALLATIONS:

Here, the report may include the best information, such as the following, for a stated period of time:

Reduced accident rate (percentage or number)

Reduced crime rate (percentage or number)

Better business (well-lighted streets draw trade—statement, preferably by Chamber of Commerce, newspaper, etc.)

Faster flow of traffic

Comparative cost of current

Lower maintenance cost

Increased goodwill toward utility or municipality

FLOODLIGHTING INSTALLATIONS: Report may include information such as the following for a stated period of time:

Sports Floodlighting—

Increased attendance (percentage or number)

Greater receipts pay for lighting equipment

Service Stations—

Increase in sales of gas and oil (percentage)

Increase in sales of other merchandise

Increase in lubrication and wash business

Greater customer satisfaction, resulting from improved service

Industrial—

Lower accident rate (percentage or number)

Speedier handling of materials (statement, preferably by customer)

Fewer losses from theft (statement, preferably by customer)

Any additional information that will further clarify details of lighting installations will, in each case, give your report greater value.

HOW TO USE CARBIDE DRILLS

[FROM PAGE 78]

ble drills are satisfactory when the carbide tipped masonry drill is being used for cutting holes in ordinary masonry materials.

The more pressure you can put on the drill, the better it will work. Using a lever to apply greater pressure is perfectly permissible. If a hard stone is encountered which will not cut, lift the drill and slam it down against the pebble to break it. Don't be afraid of breaking the carbide. It's tough. Don't try to "worry" through the obstruction. This would just dull the drill.

Dry drilling will be found to give excellent results in the majority of cases. However, use of a coolant will often be found desirable when drilling such materials as glazed tile, porcelain, marble, etc. Turpentine has proved preferable as a lubricant in such instances, although either kerosene or water will give good results. When using a coolant of any nature, be sure that the supply is ample enough to keep the carbide tip of the drill wet at all times.

Sharpening

Carboloy masonry drills can be sharpened on any tool grinder. Either C100-18V or C80-18-V silicon carbide grinding wheels should be used, however. Quality wheels, made by several reliable manufacturers, are obtainable at any mill supply house.

The following rules are important to good sharpening practice:—

1. All new Carboloy masonry drills have a 10° relief angle. This is the angle to grind when re-sharpening.
2. In order for the carbide tip to cut properly, it must project at least 1/32" beyond the shank material. If it does not extend this far beyond the steel shank, the carbide will not cut and the shank will "drag" in the hole. After a number of re-sharpenings, grind away the steel behind the carbide tip to prevent "dragging."
3. Use a moderate pressure. Keep the drill moving continually across the grinding wheel.
4. Never dip in liquids to cool it during or immediately after grinding.

Operational Hints

Keep Holes Clean—All rotating drills operate better if the holes are

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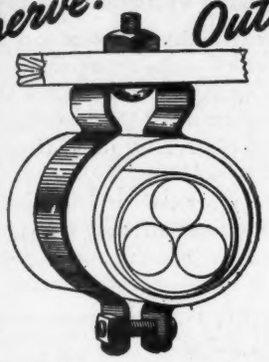
Steel HANGERS, CLIPS, STRAPS

Outserve! Outlast!



Minerallac Cable, Conduit and Messenger Hangers are STEEL. Easier, quicker to install; permit speedy, compact wiring; economical. Also in Everdur . . . Porcelain Insulating Bushings available.

* * *

Jiffy STEEL Clips (Pipe-clamp) require only one screw, nail or bolt; rib-strengthened; for hanging pipe, conduit, BX cable, mounting coils, etc. Millions in use.

* * *

Steel Straps for Messenger cable services on outlet boxes; may be used in conjunction with hangers.

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New **NON-INDUCTIVE CABLE RACK**

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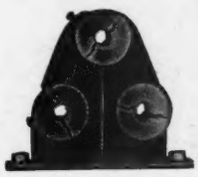

Type D-F 3-Conductor Cable Rack, New Non-Inductive Design. Racks available for Cable sizes from 5/16 to 2¾".

● Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked Cables only partially surrounded by metal eliminates any chance of induced current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction . . . Installation of cables made quick and easy through the use of split bushing.

Send today for Bulletin C-S-51 which illustrates the complete line

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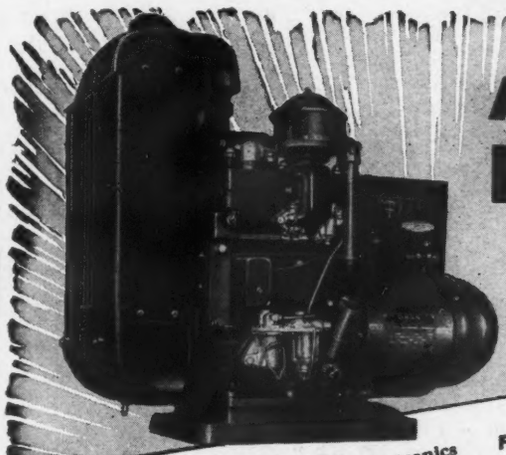

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ONAN Electric Plants: A.C.-350 to 35,000 watts in standard voltages and frequencies. D.C.-600 to 10,000 watts, 115 and 230 volts. Battery chargers—500 to 6,000 watts, 6 to 115 volts.

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kept clean. This is automatically taken care of when using the masonry drills on walls and ceilings. For deep holes in floors, however, some provision should be made for cleaning the holes. A compressed air blast or a continuous flow of water have been found to work well. The depth to which a hole can be drilled with a Carboloy masonry drill depends partly upon the extent to which the hole can be kept clear.

Penetrating Glazed Surfaces—Since it is difficult for any drill to penetrate the outside layer of a glazed surface such as is found on tile and porcelain, time can sometimes be saved by breaking an exceptionally hard glaze with a center punch or a star drill and hammer. Troublesome pebbles in concrete can also be broken up in this way.

Drilling Reinforced Concrete—Considerable care should be exercised when drilling reinforced concrete. A sharp Carboloy masonry drill gives no trouble cutting through either the concrete or the reinforcing material, but there is some danger that the drill may become wedged beside one of the reinforcing bars and break, if proper care is not taken to keep the drill straight.

For obvious reasons, it is difficult to compare accurately the performance of Carboloy masonry drills with the performance of the conventional star drill. However, it can be said that when properly used, the carbide masonry drill will—on the average—cut ordinary construction materials some four times faster and last up to fifty times longer than will conventional drills of the hardest steels.

Cutting carbon brushes for special repair work at Howard Electric Co., Detroit. Tilting table-top permits angular cuts. Drill press in background is for boring brushes to receive flexible pigtails. Factory techniques are used to make pigtail connections to brushes.